AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

VOL. 10, No. 15 } WEEKLY. | NEW YORK, APRIL 9, 1887. | { $2.50 per Annum. SINGLE COPIES, 5 CENTS.

COPYRIGHT 1887, BY AMERICAN MACHINIST PUBLISHING COMPANY.

For Sale Everywhere by Newsdealers.

ENTERED AT POST OFFICE, NEW YORK, AS SECOND CLASS MATTER.

Standard Section Lining for the Draftsman.

The adoption of a standard system of lining to indicate the nature of the materials, where sections are shown on the drawing board, is a matter of hardly less importance than the standardization of screw threads or of measures. In the preparation of a system of instruction for the technical school, the introduction of some such system is one of the first steps, and we have the pleasure of presenting herewith that which has been adopted at Sibley College, Cornell University, at the suggestion of the Director, Dr. R. H. Thurston, by Professor Cleaves, the Professor of Drawing, as prepared by Mr. Van Vleck, who has special charge of the work of this nature in the course of mechanical engineering.

The "Sibley College of Mechanical Engineering and the Mechanic Arts" is the school of mechanical engineering of Cornell University, and comprehends all work in that and immediately related departments. Its principal courses are undergraduate courses in mechanical and electrical engineering, including extended courses of instruction in workshops, drawing rooms, and in mathematics, the sciences, and applied mechanics, and the theory and arts of engineering; as well as post-graduate and special courses in marine engineering, steam engineering, and the mechanical engineering of railways. A very finely equipped department of civil engineering has been in operation at Cornell University many years, and has sent out about 20 per cent. of all the graduates of the university.

The department of drawing at the Sibley College includes a sub-department of freehand drawing and industrial art, and a sub-department of mechanical drawing. The former takes charge of all students in engineering, and in several other of the University courses, as well as of the mechanical engineers, and gives two terms to their instruction in freehand drawing, and in machine sketching; after which the engineers go into the study of descriptive geometry and the use of instruments, while the others, if desirous of doing so, continue in the industrial art course, taking modeling, sketching, coloring, painting, and such advanced work in that course as their time, talents, and inclination or opportunity may permit. The latter of the two departments takes charge of all students in the professional course, at the beginning of the second term—the two working together during that term—and introduces them to the study and practice of mechanical drawing, beginning with the use of the drawing instruments and office practice. Space will not permit, even were it our present intention, to indicate the extent or character of the details of work in this department, in the latter part of the course, which includes a long period of work in machine design, and in kinematics applied on the drawing board. The attempt is made, throughout the course in all departments, to make every division contribute to every other, the drawing rooms supplying the drawings and blue prints for the shops, the shops making all that the other departments call for, and each shop supplying the others, and the whole forming a systematic but closely interknit fabric that has the highest possible total efficiency.

The first step in the work of the department of mechanical drawing is to make the students familiar with their tools, and to teach them what is considered good work in the simple formation of lines. For this purpose, studies are prepared and lithographed, of which plate 1 is an illustration; the construction of which compels the student to be exceedingly careful in the terminating of his lines, and in making junctions. Any one who can produce this plate creditably will find no difficulty in making any ordinary straight line drawing with ease and accuracy, if not with elegance. This plate and its studies are practiced upon until the student can use his instruments for right line drawing with neatness, rapidity, and accuracy. He is then ready to attempt the use of his dividers.

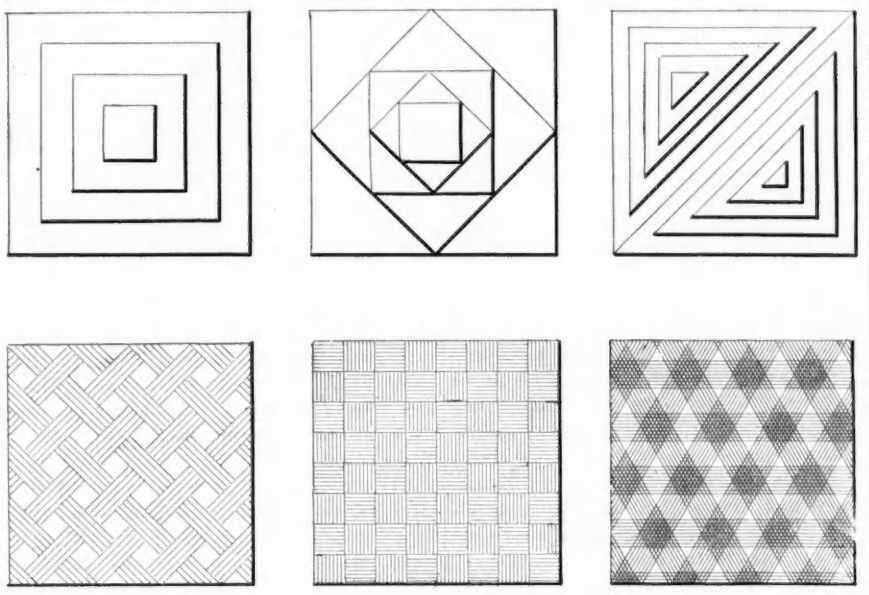


PLATE 1.

Plate 2 is a copy of the second set of studies adopted as the standard, for the present at least, in the Sibley College department of drawing. It is seen to include sets of curves, so arranged and so related, that the practice of the student in the use of the dividers is made just as systematic, and just as fruitful of result, as that just exhibited in the combination of straight lines of plate 1. He practices these exercises until he can as quickly, and as skillfully and neatly, reproduce all these curves as the studies of the preceding plate. This being done, he comes to the third plate, that to which our attention has been particularly called, as illustrating not only a good drawing room exercise, but, more especially, as an example of careful standardization of the elements of a conventional system of drawing board illustration.

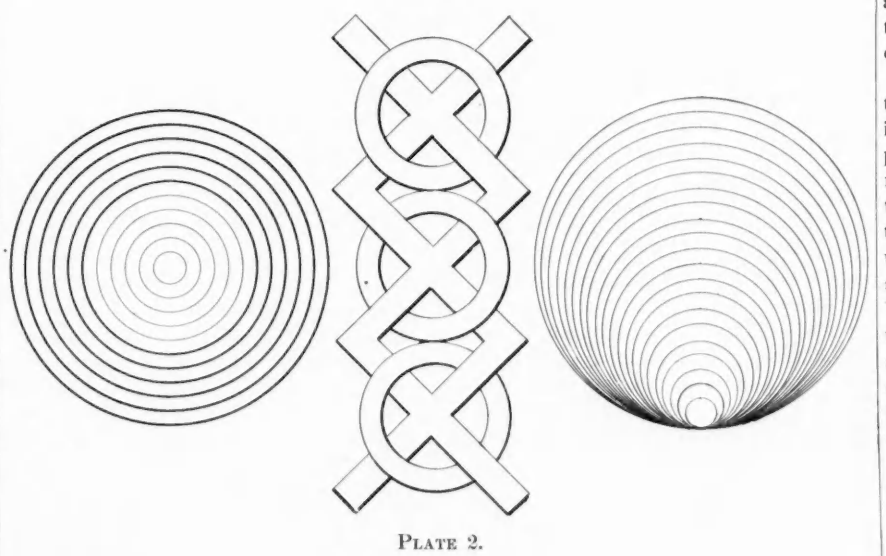


PLATE 2.

Plate 3 is the third set of exercises attempted by the young engineer before going into the work of the course, which demands primarily a good knowledge of the instruments and skill in handling them. This is the set of standard sections which is used to represent the various common materials used in the construction of machines. This set was made up originally by Mr. Van Vleck, with the approval of the director of the college and the head of the department, and has the endorsement of the former as the officially adopted standard of Sibley College. It was decided upon after a very careful study of the sections proposed by the best and most generally accepted authorities, none of whom are quite in accord with all their contemporaries. The endeavor was made to secure such a set of conventional section linings as would at once be expressive, simple, easily kept in mind, and readily constructed by the average draftsman, and such as should be at all times recognized by the profession as standard if it should once become generally adopted.

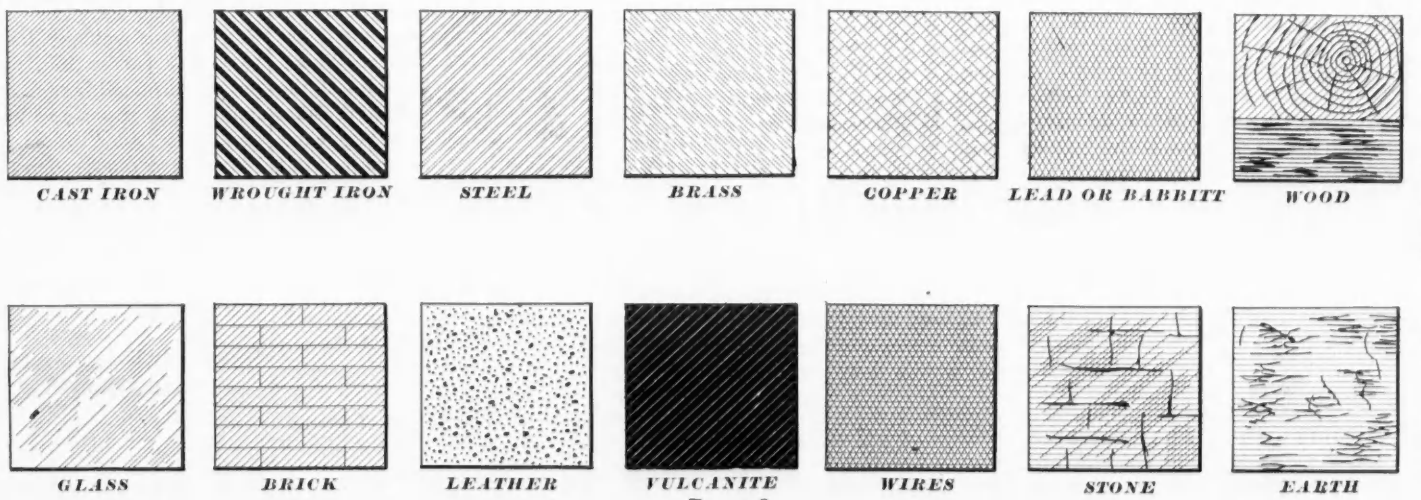


PLATE 3.

The plate is seen to represent the sections for cast and wrought-iron, steel, brass or bronze, copper, lead or other white metal, wood, glass, brick, leather, vulcanite, sections of masses of wire—as used in electrical engineering—stone and earth. Where possible, as in the cases of wood, glass, leather,

vulcanite, masses of wire, stone, and earth, it has been found possible to imitate, to some extent, the natural appearance of the material; in the other cases this has not been found as practicable, but a hint of their predominant visible characteristics may be gained by the examination of these sections, some of which are already long established and well settled among the larger drawing offices as standard. No attempt at novelty has been aimed at, as that would defeat the very object sought—the presentation to students of sections that they may at once adopt, and use later when they have entered upon their working careers.

Hidden Line

Line of Motion

Dimension Line

Centre Line

On the plate above are given a set of standards proposed for the various broken lines, the purposes of which are as distinct, and as much needed, as the preceding sections. The "Hidden Line," outlining parts of the construction which do not appear at the surface shown by the drawing or on the given section, is, at the Sibley College, a dotted line, consisting of dashes and spaces, the one having about double the length of the other, and all line-work having a weight adapted to the purpose in view. The "Line of Motion" is a dotted line in which the dash and the space are of equal length. This line indicates the path of a moving element of a machine, and is used in all constructions in kinematic drawing. Wherever motions are to be exhibited, or problems involving the determination of the effects of combinations of related motions, or parts of machinery, are to be solved, this line is the standard line to be used. The "Dimension-Line" is one having for its office the indication of the distances between any two parts or points on the drawing, and it is usually terminated at each end by an arrow-head. Dimensions given in figures are written on this line, wherever convenient, between the two points joined by it. The "Center-Line" is a line seen on every drawing of apparatus or mechanism in which the line about which a part, or combination of parts, is symmetrical to be shown. Thus the center-line of a steam cylinder, the center-line of a shaft, or the line in kinematic drawing, about which any element revolves, can be made in this manner. The dimension-line thus is made to consist of alternate long and short dashes, the one having about twice the length of the other—separated by short breaks; while the center-line is of the same kind, except that there are two short dashes to each longer one.

The following from *The Engineer* may be of interest to those in this country who have an ardent desire to go beyond the limits of the United States to purchase articles in the iron line. We believe that no practice of the kind can be found in this country.

"All who have at heart the commercial reputation of Great Britain cannot but view with dismay the revelations recently made in connection with the iron trade. It has been proved beyond a doubt that the practice is by no means uncommon of stamping inferior makes of finished iron with imitations of well-known brands. A circular issued last year by the South Staffordshire Ironmasters' Association, states plainly, as the result of proved facts, that it has been the practice of unscrupulous dealers to mingle a small quantity of genuine iron, every rod or bar of which is branded, with a large quantity of a cheaper make, not possessing the same strength or intrinsic value. In one instance that has come to light, only four tons of the genuine quality of iron were used in sixty tons of chain specified to be of high-class branded iron; and in another, all the iron in a chain was of a quality inferior to that specified, although a certificate of test was given by the maker of the chain. The value of such a certificate will be dealt with below; meanwhile we will show how the chain is made up so as to consist apparently of the high-class iron stipulated for. It is the practice of leading ironmasters to have a well-known brand stamped upon every bar; and this brand an unscrupulous chainmaker takes good care to preserve intact upon as many links as possible, and if each bar were stamped twice over, by mistake or otherwise, his purpose would be all the better served. The remaining links are then made up of unbranded and inferior, though not necessarily bad iron, and it is left to be inferred that they are composed of those portions of the rod in which the brand does not occur, or that the brand has been obliterated at the weld."

Applying for Situations.

Should a mechanic or salesman, answering the advertisement of a manufacturing establishment wanting a man to fill a vacant position, enclose a postage stamp with his application? No, if the application is sent to the address named in the advertisement. The advertiser wants a man competent to do certain work, and is presumably just as anxious to find the right man, as the right man is anxious to be found. The advertiser, just as much as the applicant, is the obliged party. The transaction is, or should be, regarded, not in the light of a personal favor to any one, but purely as a matter of business on both sides.

Will enclosing a stamp in such cases help the applicant's chances? No, because no employer is likely to be bribed by a two cent stamp into selecting a man to fill an important place, who is, on his own showing of his qualifications and experience, clearly less competent than other applicants. Furthermore, no such advertisement ever solicits the sending of stamps.

Courtesy only requires that a stamp should accompany letters of interest to the writer alone. The main thing is to put the application in clear, business-like shape, as befits the aspirant to a place of trust and responsibility.

Should an applicant for such a place blame anybody but himself for the result, if haste and carelessness are plainly apparent in his letter asking for the situation? No, the man who rushes carelessly and blunderingly into the preparation of a letter, which may prove the turning-point of his whole life, does not greatly strengthen the prospect of its turning the right way.

Should applicants for such a situation enclose original reference papers? No, because copies are just as easily verified, and will answer every purpose. Original documents of that sort are valuable, and should not be exposed to needless risk of being lost or mislaid.

The verdict that the overhead telegraph wires must go—underground—was reinforced by the burning of a large hotel in Buffalo. The work of rescue was seriously and fatally impeded by the usual network of wires. Judging from the experience in New York, if Buffalo moves energetically in the matter of burying the wires, some of them will be underground inside of fifty years.

Anent the railroad disaster at Forest Hill, the Manchester *Union* remarks:

"Somehow or other railway presidents and directors are never on the train. They always appear to be born immortal."

We think it has been previously remarked that doctors seldom take their own remedies.

If there is one thing of which American manufacturers may justly feel proud it is their reputation for furnishing exactly what they contract to furnish, both as to material and workmanship. With no intention to boast of this, the belaborings which English technical journals are giving manufacturers for their shortcomings may well lead us to a little pride in the matter. Chains, we are told, are made in England with an occasional link only of good iron; articles of hardware are sent abroad which are so abominably bad that trade is ruined thereby, textile fabrics are about as bad as bad can be, and so on through the list. We should be sorry to give English manufacturers so poor a character as they get from their own technical press.

Promoting Firemen.

By J. A. Hill.

Some two or three years ago I wrote an article for this paper on the above subject over the signature of "An Engineer." My idea has not undergone any material changes since then, but I have thought of many details to the plan.

In the first place it should be thoroughly understood by all men in the service that the great investment of wealth in a railroad plant, the shops, round houses, fine depots, offices, right of way, track, bridge and water supply, and all the men employed at them, do not earn one cent of money for the company. They are expense—a necessary evil as it were. The wheels are all of the great outfit that earn money, and then only when in motion. When the engines are still there is no revenue coming in and lots going out. This being known, every other department should be subservient to the transportation department, and as it takes engines to pull cars, every effort should be made to keep these machines in the best possible repair, and in such condition that they can handle their trains at all times with safety and dispatch. Then the fireman who can keep his mill "hot" and reasonably clean is better than the one who cannot, and the engineer who can get over the road with a full train with less fuel, oil, stores or repair is worth more to the company employing him than the other fellow who uses up everything in sight. The man who can so handle his engine as to avoid excessive slipping—thus running many miles more with one set of driving tires—is worth much more as an engineer than one who does not exercise that care and judgment, as is also the man who can carry his water above the crown sheet and below the throttle, thus saving heavy expense in facing valves, boring cylinders and renewing packing, to say nothing of ruined paint and brass from the slobber of the stack, and an occasional cylinder head knocked out by water.

Men employed by private works consider it honorable to be economical in all things, and as seeking to advance their employers interests, but it has grown to be so that on most roads it is considered a disgrace among the men to try to do anything of the kind, and a man who tries, and lets it be known, is marked down as a "sucker," and aspiring to be promoted to some high position on the misfortune of his fellows, and so strong a hold has this feeling got that the most economical men are held at a level of the poorest, just to be considered honorable. The prize system has saved a great deal of coal and oil to some companies, but it has made liars and schemers of many good men. The system of putting up bulletins of the performance of the engines on each division is a good practice, but should be very carefully guarded. The loss from leaking, and in round house and office use should not be averaged to engines "to account for it," and all supplies should be issued by weight. Guessing at coal, oil and tallow is a poor way to tell what the engines are doing. Honorable competition would keep the men in reasonable bounds. Many a hot pin and ruined brass has been caused by prize-gotten stinginess.

But I started in on the subject of promotion, but wanted to convey a slight idea of what I should consider some of the qualifications for promotion. I do not think I should promote all engineers, but should hire men often when found to possess the necessary qualifications, but every man in the service should be in the line of promotion, and when a man was found firing an engine whom it would be impossible to promote, in justice to the company, the public or the man, he should not be kept in the service. A fireman unable to read or write, one who was addicted to drink, unreliable, dishonorable, dishonest, or possessing any fault that could not be overlooked in a first-class passenger engineer, is holding a job that keeps some good man from advancement. From the ranks of the firemen must come the runners, so I should be very careful about the men who become firemen, and a man who showed up all these qualifications after promotion should not be discharged for any slight mistake or oversight. Men 35 or 40 years of age are too old to go firing, just as much as they are too old to learn to be carpenters or jewelers. There are many young, intelligent boys who are anxious to go firing, and if they spend a year in the shops most of their bad faults would be exposed and the culls could be thrown out. A lazy, listless, thickheaded dull shop boy makes the same kind of a fireman and a worse engineer. I do not think I am exactly a crank on phrenology, but I do not honestly think a man who wears a number six hat can be a successful engineer or a desirable fireman. A head wants the bumps of caution, judgment, coolness and a natural adaptation to the handling of machinery well defined—if these bumps are in the head—a man running an engine wants to be capable of thinking of three or four different things inside of fifteen or twenty minutes. The safety and success of every other department of the road depends upon the handling of the engines, hence the engineers should be the best railroad men in the service.

It is almost impossible for a division master mechanic or round house foreman to attend to his other duties and give this subject the attention it really deserves and needs, and on a road of any size I believe an assistant in charge of the men—if a good man was secured—who could hire, promote, and discharge all employes of the motive power department, would be a paying investment. The plan of promotion by seniority alone is a miserable plan unless all the men are otherwise equal—and they never are. When it is known that promotion will follow qualification and merit, there will be no hunting of "soft snaps" to wait for "my turn." Every man will be up and doing and the officers will receive pleasure and the stockholders profit thereby.

Literary Notes.

The colored race have several newspapers of first-class merit, but, musical as they are, none of them until now have started a musical journal. The new venture is the *Musical Messenger* of Montgomery, Ala., a monthly of considerable promise. It is edited by Miss A. L. Tilghman, who has achieved high success in teaching music in that city. Her brother has been employed for several years in the mailing department of the American Machinist. The paper is $1.00 a year.

Wood and Iron, a bright monthly mechanical journal published for some years at Minneapolis, announces a change. W. P. Gregory, the manager, has sold his interest to several parties in that city who are to put in considerable capital and endeavor to improve the paper and increase its circulation. The editor will be C. L. Redfield, who is known to our readers by his articles in these columns.

E. & F. Spon, 35 Murray street, New York, issue in small pocket form a monthly list of engineering books. There are various new revisions and new books in this line appearing, and a list of them, as they appear, will be found very useful.

Consul Viosca, in reference to Lower California, says:

"The monopolization of the most important branches of its industries, such as pearl-fisheries, orchilla weed, and many of the other native products which heretofore were the only resources of the more industrious people, are now, under the present system of Government contracts, concentrated in the hands of a few capitalists, thus reducing the laboring masses to abject poverty, which compels them to work for a scant subsistence."

Cutting Tools.

By Fred. J. Miller.

SECOND PAPER.

We will first suppose the lathe to be provided with a vertically adjustable tool rest, several forms of which are in use. This of course is a simple case; because the top face of the tool is always kept parallel to the cross-slide, and consequently it is only necessary to set the tool level with the center to make its top face lie in a radial line, at all times, no matter how far it may be moved from the center by the cross-feed screw.

A similar case is found in lathes which raise and lower the tool by a screw at the back, but having the tool rest gibbed to the upper part of the carriage, as in Fig. 5. Here it will be noticed that the top face of the tool in moving to and from the center

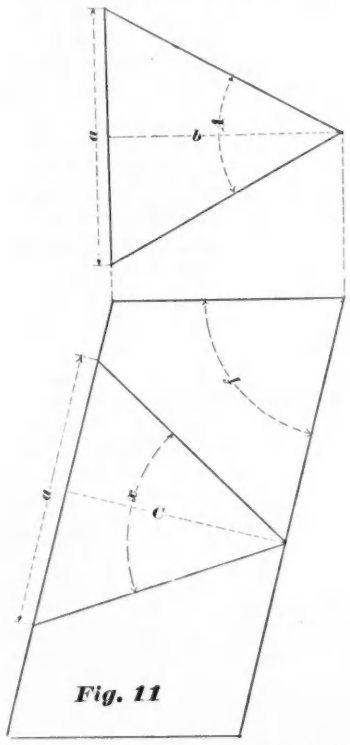


Fig. 11

will always move in a radial line, for the same reason that it does so with the vertically adjustable rest, viz., because it is always parallel to the cross-slide.

Now, it will be noticed that in Fig. 5 a thread tool, when cutting in the proper position is always below the center, and that the larger the diameter of the screw, the lower the tool must go.

Now, taking such an arrangement of carriage as is shown by Fig. 6, we have conditions differing from either of the preceding ones, because in this case, the upper face of the tool never lies in a line parallel to the cross-slide, except by accident; and it would not do to place the point of the tool and the center together, and then run the tool out by the cross-feed screw and assume it to be in correct position; and the reason will be apparent upon a little consideration of the diagram, Fig. 7. Letting the line *a b* represent the cross-slide, the point *c* the center of the lathe and the line *a c* the inclination made necessary to bring the tool to the height of the center.

Now supposing the point of the tool to be at the center, and then to be moved out by the screw, the distance *c f* representing the radius of the screw to be cut; the top of the tool will then lie in the line *d e*, which is not a radial line.

Probably the most practical way in such a case is to place the tool at the distance from the center it is to be when finishing the screw, and then adjust it so that a straight-edge placed upon its top face will come fair with the center.

Some such plan must also be adopted with lathes having tool posts, such as is shown by Fig. 8, in which the tool may need to be either above or below the center, depending upon whether it is necessary to tip it forward or backward to bring its face to lie in a radial line. If it be tipped forward it must be above the center, but if it be tipped backward it must be below.

Other conditions may arise, differing from all of those shown, but enough are here given to illustrate the principle, and to demonstrate that even in so simple a matter as the cutting of threads there is room for more thought than is sometimes bestowed upon it.

Of course for many threads, no such refinements are necessary, but there are plenty of cases in which they are. For instance, it may be required to make a U. S. Standard tap, say 1″ diameter, its size at the bottom of the thread will be .8375″, and

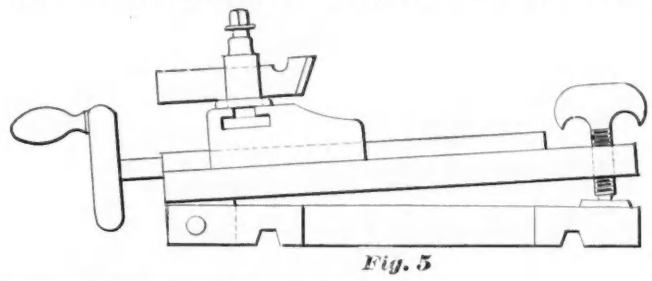


Fig. 5

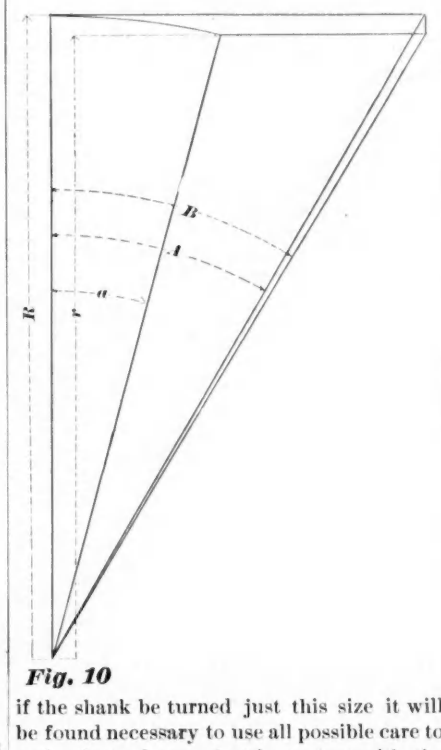


Fig. 10

if the shank be turned just this size it will be found necessary to use all possible care to make the tool come just in contact with the shank when the thread is finished, and it cannot be done unless the tool is precisely right in shape and set in the right position.

Sometimes it is required to make cutters for threading tools, and then arises a problem of angles. It has been recently shown by Mr. Rose in these columns, that the angle to which the sides must be planed or ground will not be 60°, but some angle greater than 60°, the amount of the excess depending upon the amount of clearance given the tool.*

Several years since, when confronted by this problem, I constructed the diagram Fig. 9, which is simply a graphic method of obtaining the angle, which may be easily understood by inspection. *a* is the angle of clearance, and *B* is the angle to which the tool must be formed to cut a 60° thread with the given clearance.

For the purposes of computation all that part of the diagram to the left of the central line may be dispensed with, and doing this we have the diagram Fig. 10, to which Mr. Chas. A. Bauer has adapted the following equation:

Tang. A *r* : Tang. A R: : Tang. A : Tang. B, by means of which the angle *B* may be accurately calculated. Not content with this, Mr. Bauer has constructed the diagram Fig. 11, and the formula

$$b = a \cos. \frac{A}{2}$$

when $A = 60°$

$a = 1.$

$b = .866$

$c = b \sin. f$

$$\text{Tang. } .5\ x = \left(\frac{.5\ a}{C}\right)$$

* See "Standard Screw Threads" by Joshua Rose, M. E., American Machinist, Jan. 22, page 3.

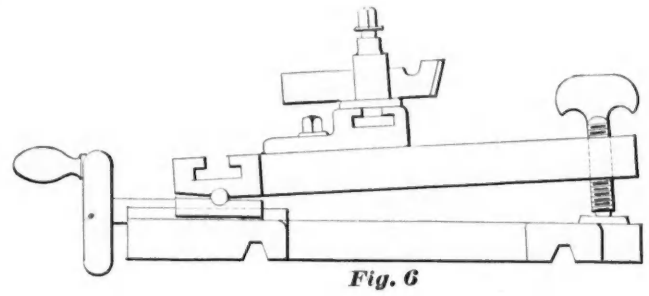


Fig. 6

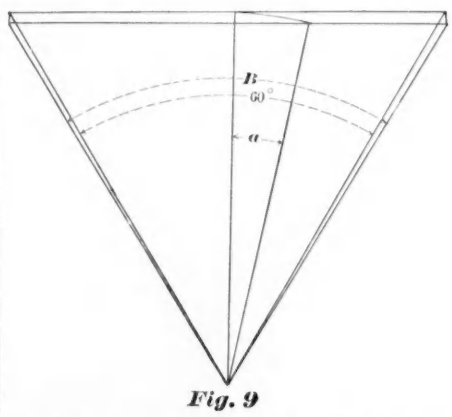


Fig. 9

but that such an improvement would meet with appreciation.

Headquarters for Master Mechanics' Convention.

J. H. Setchel, Secretary of the American Railway Master Mechanics Association, has sent the following circular to members:

Arrangements have been made with the proprietors of the Hotel Ryan, St. Paul, for the accommodation of members of the Association and their friends who will attend the 20th Annual Convention, to be held at St. Paul, commencing Tuesday, June 21st, 1877.

The charges will be $2.50 per day for each person. Additional charge for extra accommodations.

Members requiring rooms are requested to engage them, if possible, before June 1st, by filling up the enclosed blank and mailing it to the Hotel Ryan, St. Paul, Minn. Any members who, after having secured rooms as above, find themselves unable to attend, will confer a favor by notifying the proprietors of the Hotel Ryan at as early a date as possible.

G. W. Cushing,
Clem Hackney,
R. W. Bushnell,
Committee.

Stearns' New Bench Drill.

Stearns' New Bench Drill.

The entirely new feature of this drill consists in the spindle being fed down quickly to the work by simply turning the crank, and by reversing the motion of the crank the spindle is as quickly drawn from the work.

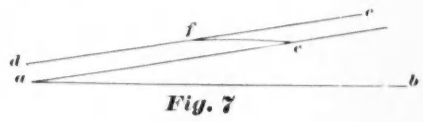


Fig. 7

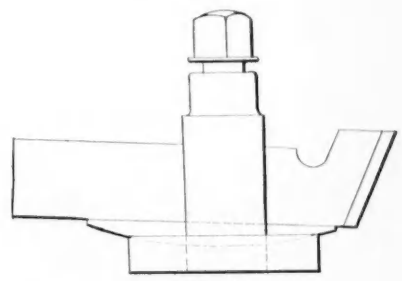


Fig. 8

It is 24 inches high, drills $\frac{1}{8}$ to $\frac{1}{2}$ inch hole square with the bed plate. The run of the screw is $3\frac{1}{2}$ inches, and the drill stock is $1\frac{3}{16}$ inch in diameter.

Each drill is furnished with a chuck which attaches to the spindle and will hold a $\frac{3}{8}$ round drill, or the ordinary square tapered shank or brace drill. The balance wheel weighs 6 pounds, which is sufficient to carry an ordinary drill smoothly, and is not heavy enough to break small drills. The bearings are carefully finished with standard size reamers, and all parts are interchangeable. The crank has an extension for large drilling, and all allowances are made for strength and durability. The main standard is nicely japanned, the hand wheel nickel plated, and the balance wheel painted vermilion, the combination not only making a useful and attractive but a highly finished machine.

E. C. Stearns & Co., Syracuse, N. Y., are the manufacturers.

A Mechanical Engineer in Politics.

To the discredit of the voters of the country, we are bound to believe, it is not often that a mechanical engineer is put forward for political preference. An exception is made this year in Chicago, by the nomination for mayor of John A. Roche, a member of the American Society of Mechanical Engineers. Mr. Roche is a young man—44 years of age—who served a regular apprenticeship as a machinist and has worked up through important mechanical positions to that of Chicago manager for the world-wide known firm of J. A. Fay & Co. We are not in politics, and hence cannot judge what his prospects of election are. If he does not get elected we shall console ourselves with the knowledge that the machinery trade has retained an honorable and valuable member.

Practical Drawing.

By J. G. A. Meyer.

TWENTY-FIRST PAPER.

Problem 33.

198. TO CONSTRUCT A SQUARE ON A GIVEN LINE AS A SIDE.

Fig. 148. Let *A B* be the given line, it is required to construct a square whose sides shall be equal in length to that of *A B*.

From the end *A* of the given line as a center, and with a radius equal to the length *A B*, describe an arc *B E;* from the end *B* as a center, and with the same radius as before, describe an arc *A F*, cutting the former arc at the point *C*. Bisect the arc *C B* at the point *D*. From the point *C* as a center, and with a radius equal to the distance between the points *C* and *D*, describe an arc *E D F*, cutting the arcs *E B* and *A F* at the points *E* and *F;* join the points *A* and *E*, *B* and *F; E* and *F*, the resulting figure, will be the required square.

The arc *B C* is $\frac{1}{6}$ of the total circumference of the circle described from the center *A*, because a chord drawn from *C* to *B* will be equal to the radius *A B*, and according to Art. 190 a chord which is equal to the radius will subtend $\frac{1}{6}$ of the circumference. By construction the arc *E C* is equal to the arc *D C*, or to half the arc *C B*, consequently the arc *E B* will be equal to the sum of the arc *C B* and *C E*, or, in other words, the arc *E B* is equal to $\frac{1}{6} + \frac{1}{12}$ of the total circumference, hence the arc *E B* equal to $\frac{1}{4}$ of the circumference of the circle described from the center *A*, and, therefore, the lines *A E* and *A B* will be perpendicular to each other. See Arts. 37, 38 and 39. By construction all the straight lines are equal in length, and, consequently, the resulting figure will be the required square.

199. This square can be constructed by another method, which may sometimes be preferable to the former, thus:

Fig. 149. Let *A B* be the given line; it is required to construct on this line a square whose sides shall be equal in length to that of *A B*.

Bisect the given line *A B* by the perpendicular *D E*, and make *D E* equal in length to that of *A B;* also bisect the line *E D* by the perpendicular *H I*, and make *H I* equal to *A B* with one-half of *H I*, that is, *C I* on one side of *E D* and the other half on the opposite side. From the points *E*, *H* and *I* as centers, and with a radius equal to *A D* or *D B*, describe the arcs *F C G*, *F C A*, *G C B*, cutting each other in the points *F* and *G;* join the points *A* and *F*, *B* and *G*, *F* and *G*, by straight lines; the resulting figure will be the required square.

Directions.—In the upper part of the space marked Prob. 33 draw a straight line 15 inches long by a $1\frac{1}{2}$ inch scale; on this line as a side, construct a square according to the method given in Art. 198.

In the lower part of the same space draw a line 6 inches long by a 3 inch scale, and on this line as a side, construct a square according to Art. 199.

Draftsman's Method.—When a large square is to be drawn on the floor, one of the foregoing geometrical methods is adopted. For drawing squares on the drawing board—these are generally comparatively small—the draftsman omits the geometrical method, lays off the lengths of the sides by a scale, and uses the T square for the horizontal lines, and the set square for the vertical lines, in a manner similar to that shown in Fig. 50. If the sides of the square are not horizontal or vertical, the T and set squares are used in a manner similar to that shown in Figs. 71 and 80.

The student will be benefited by drawing on a separate piece of paper squares in position in which the sides are not horizontal or vertical, and using the T and set squares in a manner as shown in Figs. 71 and 80.

Problem 34.

200. TO INSCRIBE A SQUARE IN A GIVEN CIRCLE, AND TO CIRCUMSCRIBE A SQUARE ABOUT THE SAME CIRCLE.

Fig. 150. Let *A B E* be the given circle; it is required—first, to inscribe a square in this circle; second, to circumscribe a square about the same circle.

Through the center *C* draw any diameter, as *G F;* also through the center *C* draw the diameter *H I* perpendicular to *G F;* join the points *F* and *I*, *G* and *I*, etc., by straight lines; these lines will be the sides of the inscribed square.

201. To circumscribe a square about the same circle, Fig. 150, the sides of the circumscribed square to be parallel to those of the inscribed square.

Bisect the arcs subtended by the chords or sides of the inscribed square, thus obtaining the points *A B D* and *E;* through these points draw lines tangent to the circle, and let the lengths of these tangents be terminated by their points of intersection; the resulting figure will be the required square.

If the square is to be circumscribed about a given circle, when a square is not inscribed in the same, then draw two diameters perpendicular to each other, and through their ends draw tangents; the resulting figure will be the required square.

Directions.—In the space marked Prob. 34 draw a circle 23 inches in diameter by a $1\frac{1}{2}$ inch scale; then inscribe a square, and about the same circle circumscribe a square whose sides will be parallel to those of the inscribed square by the method given in this article.

Draftsman's Method.—When the given circle is very large and drawn on the floor, the geometrical method given is adopted for inscribing and circumscribing the squares.

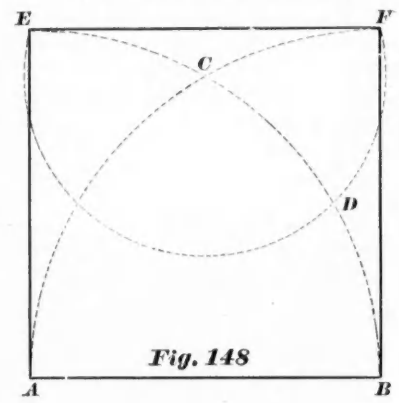


Fig. 148

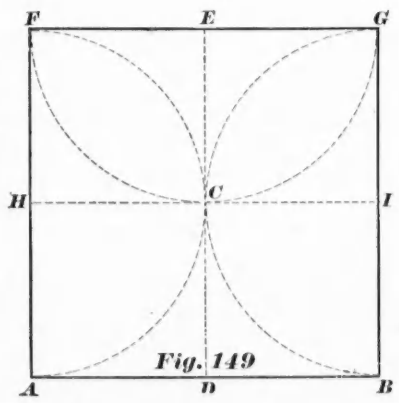


Fig. 149

When squares are to be circumscribed about circles on the drawing board—which are generally small—the draftsman will omit drawing the diameters, and draw the sides of the square tangent to the circle with the aid of the T square and the set square shown in Fig. 49, using this set square in manner similar to that shown in Fig. 146, although in the latter another set square is used. But when the square is to be inscribed in a given circle, the draftsman will first draw the diameters perpendicular to each other, and join their ends by straight lines; in fact, he follows the geometrical method.

202. Generally, when squares are to be drawn, the draftsman will first draw a circle whose diameter is equal to the length of one side, and then draw the sides of the square tangent to this circle; after this, the circle is erased. By adopting this method, fewer measurements will have to be laid off, and consequently time saved.

Problem 35.

203. TO CONSTRUCT ON A GIVEN LINE AS A SIDE, A REGULAR POLYGON OF ANY REQUIRED NUMBER OF SIDES.

For the solution of this problem one of the two following methods can be adopted; the writer believes that the first one to be given will lead with greater certainty to correct result than the second one.

Fig. 151. Let it be required to construct on the given line *A B* a regular polygon of 5 sides.

First Method.—From the end *A* of the given line *A B* as a center, and with a radius equal to the given line *A B*, describe a semicircle *B* 2 *C*, and divide it into as many equal parts as the polygon is to have sides, namely five: Mark these points of division 1, 2, 3, 4. In marking these points, always commence from that part of the diameter, *C B*, which does not represent the given side of the polygon. Through the point *A*, and through the point of division marked 2, draw a straight line *A* 2; this line will be another side of the required polygon.

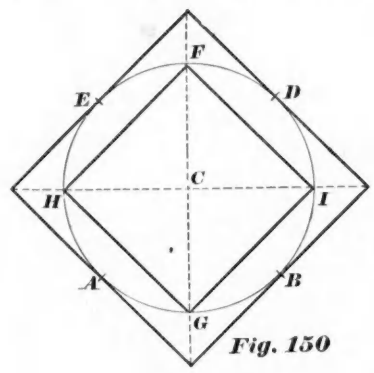


Fig. 150

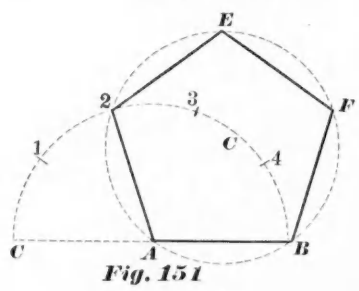


Fig. 151

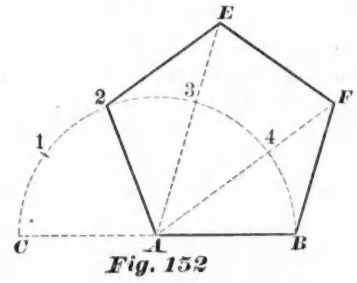


Fig. 152

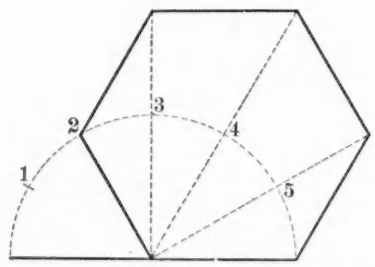


Fig. 153

But since all regular polygons can be inscribed in a circle (Art. 178), and since *A B* and *A* 2 are sides of the polygon, it follows that we have three points, namely *A B* and 2 of the circumscribed circle. Find the center of this circle according to Art. 125, and describe the circle. From the point 2 lay off in succession three chords, each equal to the given line *A B;* the last chord will meet the line *A B* at *B;* these chords will be the sides of the required polygon.

Second Method.—Fig. 152. Describe the semicircle *C* 2 *B;* divide it into five equal parts, mark the points of division, and draw the line *A* 2; so far this construction is precisely the same as that in the first method. Now, through the points *A* and 3 draw the line *A E;* also through the points *A* and 4 draw the line *A F*. From the point 2 as a center, and with a radius equal to the given line *A B*, describe a short arc, cutting the line *A E* in the point *E;* join the points *E* and 2 by a straight line; *E* 2 will be another side of the polygon. From the point *E* as a center, and with a radius equal to *A B*, describe a short arc, cutting *A F* in the point *F;* join *E* and *F;* also join *F* and *B* by straight lines, and the required polygon will be completed.

In a similar manner a polygon of any number of sides can be constructed on a given line as a side. Thus, from the end of the given line as a center, and with a radius equal to the given line, describe a semicircle, and divide it into as many equal parts as the polygon is to have sides; mark these points of division 1, 2, 3, etc.; in doing so, always commence from that part of the diameter which does not represent the given side of the polygon, as previously stated. Then, always through the point of division marked 2 and the center of the diameter of the semicircle, draw the second side of the polygon; and after this follow the first or second method given in this article. By the second method a regular hexagon can be constructed, as shown in Fig. 153, which is sufficiently plain without any further explanation.

Directions.—In the space marked Prob. 35 draw two straight lines, each six inches long, by a 3-inch scale. On one of these lines construct a regular polygon of five sides, by the first method given in this article; and on the second line construct a regular polygon of seven sides, by the second method.

Draftsman's Method.—In machine drawing we have mostly to draw triangles, squares and hexagons, and methods for drawing these have already been given. When regular polygons of five, seven, eight, or a greater number of sides are to be drawn, the geometrical methods given in this article are generally adopted, particularly when the regular polygons are very large.

Appreciating a Foundry Foreman.

It is always gratifying to note expressions of good will and esteem between proprietors, superintendents and foremen on the one hand and the whole body of workmen in an establishment on the other. We recently mentioned that Mr. Thomas D. West, the well-known foundry contributor to the American Machinist, had left the position of foreman of the Cuyahoga foundry in Cleveland to start a foundry on his own account in that city. Upon leaving the works he was presented by the men with a fine watch and chain.

In presenting this token of esteem William Lalley, on the part of all the men in the foundry, said:

"We as men with you as foreman for the past five years, having learned in that time of your high regard and appreciation of those under you, we desire as you are about to leave and to go into business for yourself, to give you some token of our esteem; therefore, as it were, we have watched patiently for the occasion. Now that the time is at hand and the hands at the time we present you with this light token of our esteem."

In response Mr. West said:

"I am too deeply affected by this pleasant surprise and demonstration of your warm friendship to properly express to you my feelings and thanks for this elegant present, a token of your good will and esteem. I shall carry and use the watch with the greatest of pride and pleasure, and will ever kindly remember its donors and my pleasant association with you for the past five years within the walls of the "Old Cuyahoga Works."

Mr. West certainly has abundant evidence of his success both from proprietors and workmen.

Steel or Iron?

In regard to the use or iron or steel for crank-pins, slides, axles and piston-rods M. C. Wheeler, Master Mechanic of the Chicago, St. Paul and Kansas City Railroad, writes us:

"I do not believe in discarding either one or the other. Wrought-iron and steel should each take its place in the construction of the locomotive. I think the question should be where does steel or wrought-iron show the best results in wear or breakage on the different parts of the machinery of a locomotive? My experience as an engineer does not favor steel for axles or crank-pins, but for valve stems or piston-rods and crossheads steel is far superior to wrought-iron in my opinion. Where wrought-iron can be case-hardened, such as guides, links, pins, etc., I do not see how you can better it with steel. I would like to ask: What is the difference between a very low grade of steel or a very mild steel, and a No. 1 quality of good wrought-iron?"

Simple Forms for Strength of Materials.

By C. L. Redfield.

A paper read before the Mechanics Institute of Minneapolis, Minn.

The mathematical formulæ relating to mechanical subjects are generally given in such an intricate and cumbersome form as to make them totally unfit for the every-day use of the ordinary mechanic. They are so filled up with *xs* and *ys*, moduli, coefficients, known quantities, fractions, etc., that nobody but the expert mathematician can use them, and even he has often to go through considerable skirmishing before he can bring any result from them.

What are wanted are simple forms or results, readily understood and easily remembered, from which, by the knowledge of the principles involved, a mechanic may easily obtain the results for any other conditions.

It is in the strength of materials that the greatest amount of mathematical foolishness occurs. While absolute accuracy in calculations is essential in many forms of construction, that plan which guesses at some arbitrary value for the ultimate strength of material, and then divides this first arbitrary assumption by a guess at some arbitrary factor of safety for a basis for calculations, then carries this basis through long and inconvenient mathematical processes, and finally arives at a result in the shape of some size such as nobody uses and hence requires another guess at the last end, quite naturally leads the practical man to sneer at the theoretical. Thus the sizes of shafts are often calculated to such diameters as 1.11, 1.27, 1.37, etc., but nobody makes these sizes, and probably nobody ever will. The sizes of shafts run in sixteenths, and vary by quarter inches, hence these sizes must be converted into sizes that can be had in the market.

All calculations for strength of materials must be tempered by judgment, and for the designer to trust his judgment as to the required strength in a special case to a certain factor of safety which is the guess, on general principles, of some professor, is, to say the least, the height of absurdity. And that plan of shoving the thumb along the rule until you come to some size that seems about right, and then saying: "Well, I guess that will do," thus trusting important constructions to the wildest kind of guessing, is equally reprehensible.

If we must have guesses and assumptions, and they seem to be unavoidable in connection with strength of materials, let them be intelligent ones, starting from some known basis, and leaving us convenient numbers with which to perform our calculations, and then when we have arrived at a result, which we know to be approximately correct for certain conditions, we use our judgment in adding to or taking from this, as we know the peculiar conditions to be.

The forms here given differ widely from those usually given in text books; the plan being in each case to give the form most easily remembered and understood. If we take the formula

33,000 pounds raised 1 foot in 1 minute = 1 horse-power,

and carefully think it over, we will find that it is exceedingly simple in expression, easily understood and easily remembered. If in addition to learning this, the mechanic knows that the power varies directly as the weight and height, and inversely as the time, he has every element required in finding any power under any conditions.

If we take this form of expression as a type and apply it to a shaft we will find that

A 1″ shaft at 100 revolutions will transmit 1 horse-power.

The additional knowledge required to use this, is that the power a shaft will transmit varies directly as the cube of the diameter, and as the number of revolutions per minute. Thus a two-inch shaft will transmit 8 horse-power at 100 revolutions, and 16 horse-power at 200 revolutions. Therefore, if we have the horse-power the required shaft would transmit at 100 revolutions, we will find the diameter of the shaft to be the cube root of this horse-power. Or we might state the rule another way, and say: The cube of the diameter of the shaft equals the horse-power at 100 revolutions. It may be urged that this becomes a rule of thumb, because it does not take into consideration the different qualities of material or the different conditions. Granted, but the mechanic who uses a rule of thumb

New Planer and Surface Gauge.

without the addition of intelligent judgment should be relegated to scraping castings or sweeping out the shop.

To illustrate the mode of applying this formula, suppose it is desired to transmit 100 horse-power through a shaft running 300 revolutions per minute; required, the size of shaft. If the shaft should be run at only 100 revolutions, it need only be capable of transmitting 33 horse-power, and by obtaining the cube root of 33 we will find the shaft to be approximately $3\frac{1}{4}''$. If we know the conditions to be such that no strains are applied to the shaft other than transmitting the power at a uniform speed, then we may take as the size of the shaft the nearest standard size below $3\frac{1}{4}''$, which is $3\frac{3}{16}''$; but if we know the shaft to be subject to heavy belt pulls, or required to carry heavy gears, then we should take the nearest size above—$3\frac{7}{16}''$. In exceptional cases it might be proper to take a size still larger. What is claimed for this formula is that it is suitable for ordinary shafting made from ordinary rolled iron and used under ordinary conditions. Should it ever become the general practice to use different material, as steel, for instance, then it would be proper to modify it to suit the strength of material used.

Arranging the expression for belting into the same form, we will have for single leather belt:

A 1″ belt, 800 feet per minute, will transmit 1 horse-power.

The power a belt will transmit varies directly as the width, the thickness and the speed. In calculations it must be assumed that this is proper for average conditions. If the pulleys are near together, or one pulley very small in comparison to the other, or the belt runs at excessive speed—say, over 5,000 feet per minute—then it is proper to allow a margin in the shape of extra width.

Applying the form to gear teeth, we will have

Gear, 1″ pitch, 1″ face, will stand a strain of 500 lbs.

The strength of the teeth varies as the width of face and the square of the pitch. Excessive width of face brings in an element not accounted for in this—the liability of breaking off a corner of the tooth. This may be practically avoided by thinning down the edge of the tooth, thus bringing the whole strain along the center. The formula is based on the assumption that one tooth has to transmit the entire strain, which will be the case if a chip or some dirt happens to get between the teeth.

If we arrange a formula for the strength of a shaft when the strain comes upon the rim of a pulley or gear, we will have

A 1″-shaft will sustain 50 pounds at 1 foot radius.

The strength of the shaft varies directly as the cube of the diameter, and the strain it will stand varies inversely as the length of the radius.

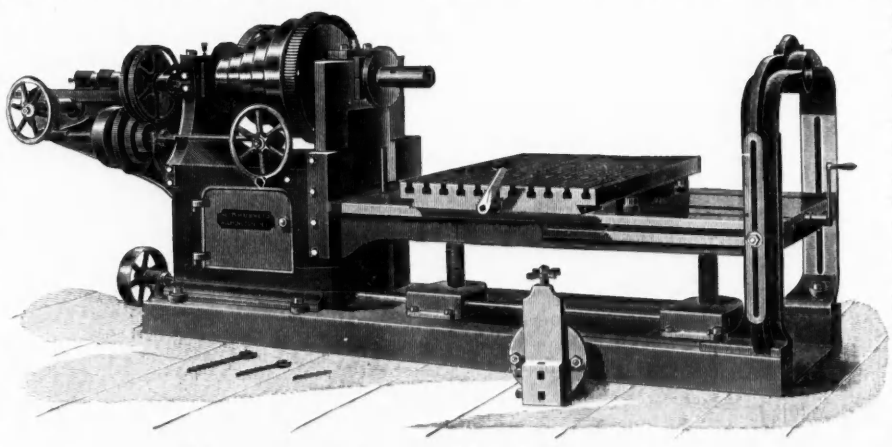
Turning to weights, we have

1 square foot of $\frac{1}{4}''$ boiler-iron weighs 10 pounds. 1″ gas pipe, 33″ long, holds 1 pound of water.

These formulæ might be continued at length; but enough is given here to show the general drift. If mechanics will jot down in their note books formulæ of this nature, and commit them to memory the same as they commit the multiplication table to memory, they will find that they have a valuable auxiliary to their every-day practice.

Horizontal Boring and Drilling Machine.

The cone pulleys on this machine have 5 speeds for 4 inch belt; it is strongly back geared, giving ten changes on the spindle, which is of cast-steel, and has 30 inch movement through the cone. The steel spindle can be driven in either direction; has a full bearing through the cast-iron spindle at all times, and does not lose any of its bearing surface as it is run out; it has a quick movement by hand through a rack and pinion. There are three changes of automatic feed by cut cog cone gearing.



Horizontal Boring and Drilling Machine.

It has a table for work 7 feet long, elevated by two screws, worm wheels and worms which are driven by power; the table carries a saddle which has a movement parallel with the main spindle; on this saddle is a cross table 36 inches by 48 inches, which can be lowered until its top is $26\frac{1}{2}$ inches from the center of the spindle, and which has a horizontal movement at right angles to it; it is also provided with a facing tool and a steady rest for the outer end of the boring bar.

The arrangement of the tables makes it easy of adjustment, whereby a number of holes can be bored without having to set the work for each hole. Its wide range makes it much preferable to a lathe for all kinds of boring.

The manufacturers are the Betts Machine Company, Wilmington, Del.

New Planer and Surface Gauge.

This little tool is one we should think every machinist, and especially those working on planers or shapers, or at die sinking and similar work, would find a valuable addition to their stock of small tools. It consists essentially of a sliding head accurately fitted to a guide standing at an angle to the base of the tool. Upon the front of this head is a shelf projecting at right angles to the base, and projecting slightly above the surface of this shelf is a steel plug hardened and ground. The guide is accurately graduated to measure vertical distances; that is, the guide rising at an angle, the graduations are enough further apart to compensate for the angularity. There is a gauge mark on the head, and bringing this to the graduations on the guide locates the top of the steel plug at the distance indicated from the bottom of the base. Setting the base on any surface and the tool to the plug gives accurate measurement, and very quickly.

In addition to this there is at one side of the head a surface gauge attachment. This is, however, entirely independent of the tool gauge, the head being tightened by one of the thumb nuts and the scriber by the other, so that there is no interference in this respect.

When desired the base is fitted with a spirit level.

The manufacturer is Arthur B. Phillips, Whitman, Mass.

Only a Brakeman Killed.

An instance of the cruelty of our modern civilization and its infinitely diversified appliances and customs is found in the fact that the death of a railway employe, through one of the minor casualties of his calling, is no longer considered worthy mention in the news columns of a metropolitan newspaper; or, if mentioned at all, a line is generally sufficient to chronicle the bare fact, details being utterly neglected. In the dispatches it used to be:

"By a broken rail seven freight cars were thrown off the track near this place last night and their contents, consisting of valuable merchandise, almost destroyed. The loss of the company will reach $15,000. Passenger trains were delayed nearly an hour. A rigid investigation will follow. One brakeman was killed."

Formerly minor accidents to employes were telegraphed to city papers, but now all correspondents are instructed to omit sending intelligence concerning the common accidents of the rail, in which employes only suffer, unless the fatalities number more than one or some unusual circumstances or causes are present. Almost every week some railway employe loses his life or a limb in the Chicago railway yards without any mention of the casualty being made in the city papers. This seems cruel, but the truth is that this sort of news is rarely worth printing. As the world goes these items are unimportant, and newsmen neglect them. But with passengers it is quite different. The commonest accident involving the safety of a passenger or injury to his person is carefully investigated and reported. And just now the papers are filled with articles demanding that the death-dealing stove shall be banished, that safety gates be put up at all crossings, and that every possible precaution be taken to secure safety for the traveling public and for pedestrians and street travelers who must cross railway tracks. But not a word is heard in behalf of the employes, whom the juggernauts of the rail are slaughtering and maiming by the thousands every year.

"Only a brakeman killed." What a story the figures of a railway tell—and, after all, there is nothing like cold figures to point a moral or tell a tale. In Massachusetts last year only one passenger in 7,584,258 was killed, and one in 2,166,931 injured. This ratio is not an alarming one, but when we come to employes the ratio is very different. There were 274 casualties to employes, 63 of which were fatal. On the Fitchburg

road one employe out of every thirty-one was injured. On other roads about one in 120. Most of these casualties were in coupling or uncoupling cars. Forty-eight, or nearly one a week, were injured in this way on one road. One can, therefore, readily believe that on almost any of our larger railways of the West a man a day is the average ratio of the rapacious demon of car-coupling. Next come casualties to trainmen from falling from trains—over one a week in the whole State of Massachusetts, and probably twice or thrice as many as in Illinois. Take the Chicago, Burlington & Quincy road for a home instance, and than the Burlington there is no better managed road in the world. In a recent year this road carried in Illinois 2,770,000 passengers. Half of a dozen of these were injured and none killed. Of the 1,500 engineers, firemen, brakemen, baggagemen, switchmen, and conductors employed in Illinois more than 200 were killed or injured. In fully one-fourth of the cases the demon coupling was the agent of injury or death. All along the line of every railway in the country, and particularly in the division station towns, where many railway employes live, will be found small armies of widows, orphans, and maimed men.—*Chicago Herald.*

LETTERS FROM PRATICAL MEN.

Says It Will Harden Cast-Iron.

Editor American Machinist:

According to my experience cast-iron may be hardened by heating to a bright red and immersing in pure lard oil.

S. Braggins.

The M. M. Should Take a Trip on the Locomotive.

Editor American Machinist:

In reading the last issue of your paper, the article relating to "Unhandy Locomotives" attracted my attention, and I wondered why somebody had not said something before; for the occasion certainly has not been wanting.

I can call to mind a number of locomotives that would be greatly benefited by having the Master Mechanic take a trip on them and assume the engineer's duties. It is safe to say that after one trip they would go to the shop, and they wouldn't come out until some important changes had been made. One would have the location of the injector changed, set about (3) three inches higher, so that it would clear the top of the reverse lever; then, when the links were dropped, the engineer might be able to keep the skin on his knuckles whole. So much for one engine. Another has the hand rail converted into a blower pipe. This is a splendid arrangement, provided the engineer and fireman have their hands encased in asbestos. Still another has the blow-off cock placed between the air tank or reservoir and back end of fire-box. There is no possible way to get at it, except to take down the tank every time you change water in the boiler. Taking down the tank and changing water makes a good Sunday job for the engineer; he don't get work enough during the week. And now another thing I noticed in the last issue, was the link motion recently brought out by the Cooke Locomotive Works. Such an arrangement is not new, as there is now running in this vicinity a locomotive with substantially the same gear, and which I remember as being quite old ten (10) years ago. The builders were Breese, Kerceland & Co., of Jersey City.

A question now and I am done. Why is it that a locomotive on the Lake Shore road with cylinders $18'' \times 24''$ requires 1,500 feet of heating surface, while a locomotive on the Pennsylvania Railroad with $19'' \times 24''$ cylinders only requires 1,205 square feet? My hair is getting quite thin on the top in trying to solve this problem. Will some one please explain? Bax.

[The valve gear alluded to in this letter was recently designed by the Cooke Locomotive Works, and successfully applied to a number of engines. We therefore published it, believing it to be the latest of its kind, and interesting to our readers. We do not know of any valve gear made precisely the same as that shown in our issue of March 26.]

The Value of Steam Generating Surface.

Editor American Machinist:

In your issue of March 26th you have an interesting communication from Mr. Richard H. Buel, and reply from F. F. H., on the value of coals.

How to get the greatest amount of power for a given sum of money should be a vital question to the steam user; but that the price paid per ton of coal is not the only factor to be considered seems evident from the data furnished, and if a comparison is to be made between large and pea coals it evidently should be made under the same conditions, as near as may be, and for this purpose a portion of the large coal should be crushed to pea size.

But there are so many conditions to be considered in a comparison of this kind that I fear you will throw this in the waste basket if it is spun out too far, so will turn directly to the question of arrangement of steam generating surface, to which attention has been attracted by Mr. Buel's communication.

It will be noticed that the two boilers with which Mr. Buel conducted his experiments were similar in construction, except that boiler No. 1 had a "generator" attached to it, and if we understand this term, it means that a portion of the heating surface of No. 1 boiler was constructed of "water tubes," while boiler No. 2 was merely the ordinary horizontal tubular boiler.

Now the question is, if the average efficiency and economy of boiler No. 1 is due to its partial construction of water tubes, what would the results have been if it had been entirely constructed of water tubes?

W. H. Odell.

Polishing Cylinder Heads—A Query.

Editor American Machinist:

In regard to keeping the work about an engine bright, I can offer experience that, perhaps, may be of interest. The greatest trouble in keeping cylinder heads and the like bright is, if you polish with dry emery cloth, the surfaces look scratched, and it is a tedious job when nuts are in the way. When oil is used with polishing powder, the hot cylinder head gets dull and yellow.

When I was steamboating on the St. Lawrence, my engine was a very highly finished, double-front beam engine, and was, in fact, all polished except the cylinder. I used to polish with emery cloth in the spring. I used the finest, and a little oil; but it matters little what the polishing is done with, as long as it is a polish (not what we call high polish and deep scratches). After all is clean, and what most engineers would call good enough, I used to take a little dry cement (any kind will do, as long as it is fine and smooth, and perfectly dry) on a clean rag or cotton waste, and rub the bright work thoroughly; the cement absorbs the oil and leaves the iron perfectly dry; and there is nothing to burn yellow, for I found that the oil, getting burnt on to the iron, formed a yellow coating, very hard to remove except with emery. The cement I used was called water lime, and a little pot full did the season's polishing, and my engine was always bright. Be careful to use only dry rag or waste, and make the powder absorb all the oil. Keep out of oil holes and bearings, and you will find your cylinder heads keep bright for weeks.

I have also a question to ask of your readers. I have charge of a large iron refuse burner where we burn large quantities of slabs and sawdust from the mill. It is made of $\frac{1}{4}''$ boiler iron, $12' \times 20' \times 20'$ high, and has a water space 12" deep all around. It resembles a large room with hollow walls, the space being full of water, the top being also covered with water which boils away very fast. My great trouble is that the iron corrodes or pits very badly; I have had it scraped every season and painted it with red lead, but still it pits, and under the angle iron ribs, where no paint can be put on, it is eating away fast; the water we use is river water, very soft, and full of slime from the pine logs. It does not injure my boilers in the least, but attacks my heater tubes and eats them through in two seasons, so I had to replace them twice. I put in galvanized iron tubes last time, which it does not eat. Now is it on account of the certain degree of heat in the heater and refuse burner (which is just about boiling point) that causes the water to eat the iron while the same water in the boiler under pressure and high degree of heat is harmless, or is it some acid set free at a certain temperature? I am going to try soda this season and watch the effect. Do you know of any remedy I could use, or what is best to be done to prevent the pitting, or have any of your readers had a like experience?

Thos. Price.

A Mechanical Institute in a Shop.

Editor American Machinist:

Seeing an article in one of your late issues regarding the good which would result if employers would take some interest in the education of their employes, I have thought it might be of some interest to you to know of a little plan which has been in operation at our works for some few months past.

During the past winter a number of the men, together with nearly all the apprentices at our works, desired to make some arrangement by which they could improve their standing as machinists, and also become acquainted with some of the many things which it is very desirable for them to know, but which it is also a somewhat difficult matter to pick up correctly around the shop.

The result of this desire has been the establishment of a class which meets every Monday evening in a room rented for the purpose.

We use no text books, nor have we made mechanical drawing or any other particular branch a specialty, but take up any subject connected with the practical working of the shop, and thus in the way of a mechanical talk, and the use of a blackboard, I explain, as near as I can, the best machine shop practice of the day.

We have spent a few evenings on geometry, another on cutting speeds for lathe and planer work. One whole evening was used in explaining the principle and use of the vernier and micrometer calipers. Considerable time has also been spent in explaining the best methods of roughing out and finishing work, and also of the varying degree of accuracy required on different jobs, or different parts of the same job.

Another subject which will be taken up before long is that of valve motion, and though the time has been when valve setting was more or less of a secret, nothing would give us more pleasure than to have every man and apprentice know the best and easiest way of setting the valves of our engines.

That the little mechanical talks have not been had in vain is abundantly proven by the fact that, with the same number of hands, fully a quarter more work is turned out than there was previously.

Besides this comes a secondary result, which is none the less appreciated. When the men see that their foreman takes some interest in them, and that they are considered as something better than so many machines, they in return are all anxious to show their appreciation of it, and thus it is that at the same time we are able to turn out more and better work; and we have also secured much better discipline, and also easier management.

My idea is that if more shops would have meetings of this kind, where the standing of their men is improved, and that less of the men around the country were connected with the different labor organizations, we should have more good contented workmen, and fewer strikes and wrangles between employers and employes.

Geo. S. Rider,
Foreman Prospect Machine and Engine Company, Cleveland, Ohio.

[This is a commendable way of imparting mechanical knowledge. It would be good for labor unions, as well as for shops. The idea of mutual help is always good to act upon.]

Heating Railway Trains by Exhaust Steam.

Mr. George A. Barnard, of this city, has perfected a simple device for heating a train of cars by using—say for a dozen cars—about five per cent. of the exhaust steam discharged from the cylinders when the engine is in motion; live steam from the boiler may be used, if needed, when the train is at a standstill. Such details as automatically discharging the water of condensation from the supply pipe under the cars, and from the heating coils within the cars, also a suitable coupling for the flexible connections between the cars, have been perfected.

The device is concentrated in the exhaust nozzles of a locomotive; they furnish the requisite steam for heating, and also by a simple arrangement, the means of applying the principle of induced currents, that creates a strong draft or suction equal to several inches of vacuum. It is this partial vacuum thus obtained in connection with the return pipe, that quickly exhausts the air from the heating coils, and drafts the exhaust steam from the exhaust pipes, through the main supply pipe under the cars, and through the heating coils.

It will be noticed that this system is devoid of complications. The principal has been proven to be correct by a continued test of several months, and will shortly be applied to a long train on a prominent road.

Mr. Barnard has exhibited his plans to several well-known railway officials and mechanical engineers. They admit its possibilities, are desirous of having a test made, and commend it for its simplicity, impossibility of scalding persons in case of accident to the train, its low cost and ease of application, and the few changes needed in engines and cars to adapt it to existing conditions.

The above we take from the *Hartford Courant.* Mr. Barnard is a mechanical engineer of extended experience in steam heating, and the arrangement referred to by our contemporary has been very carefully worked out by him from a mechanical point of view. We are thoroughly conversant with his plans, and believe they are worthy the careful consideration of railroad managers. It is well known that an almost enormous quantity of coal is burned in the furnace of a locomotive boiler, and that a large percentage of the heat generated goes to the atmosphere with the exhaust steam. It is only a small percentage of this that Mr. Barnard proposes to utilize for heating the train; so small that it is doubtful if its loss can be detected so far as the draft is concerned. The trouble with most devices worked out for heating cars, as for many other purposes, is that they are crude in design, and entirely lacking in essential features. This is not the case with the arrangement referred to. There are no missing links, so far as can be seen. As soon as suitable engravings can be prepared we shall illustrate the subject, which we are sure will be of interest.

Curious Tire Fracture.

A curious case of fractured tire occurred recently to an engine of the M. S. & L. Ry. The fracture occurred at a high speed to the engine of the 1.30 P.M. Manchester to Liverpool express, near Irlam station. A length of tire of about three feet came away from the wheel, separating at both ends and carrying away the feed clack box, so that when the train was brought to a standstill the boiler was emptied of steam and water to the clack box level. After the tire had thus ruptured, we understand that it did not come wholly away from the wheel, but remained approximately in position, one fractured end strutting against the foot plate or wheel guard, and preventing the tire from revolving, and so doing perhaps further damage or wrecking engine and even the train. The wheel center of course continued to revolve within the tire, which, being scotched as above described, skidded on the rail. The case appears curious, not merely by the double fracture, but by the peculiar sequence of events which followed and formed themselves into so fortunate and unlikely a shape.—*The Practical Engineer.*

Moulding Pulleys.

By Robert E. Masters.

The series of articles on the above subject would hardly be complete without showing one way of making a crown face pulley in loam that does not require to be turned off in the machine shop. We make these pulleys up to 12 foot diameter, 30″ face. For the benefit of the foundry reader, who is unacquainted with this class of work, we will begin at the foundation and give the details of making a combined balance wheel and crown face pulley. We will use for subject of illustration the smallest pulley we make on this plan. It is 5′ 1″ diameter, 14″ face, 1¼″ thick at edge of rim, and 2½″ in center; hub, 13″ diameter, 10½″ deep, 5½″ center core.

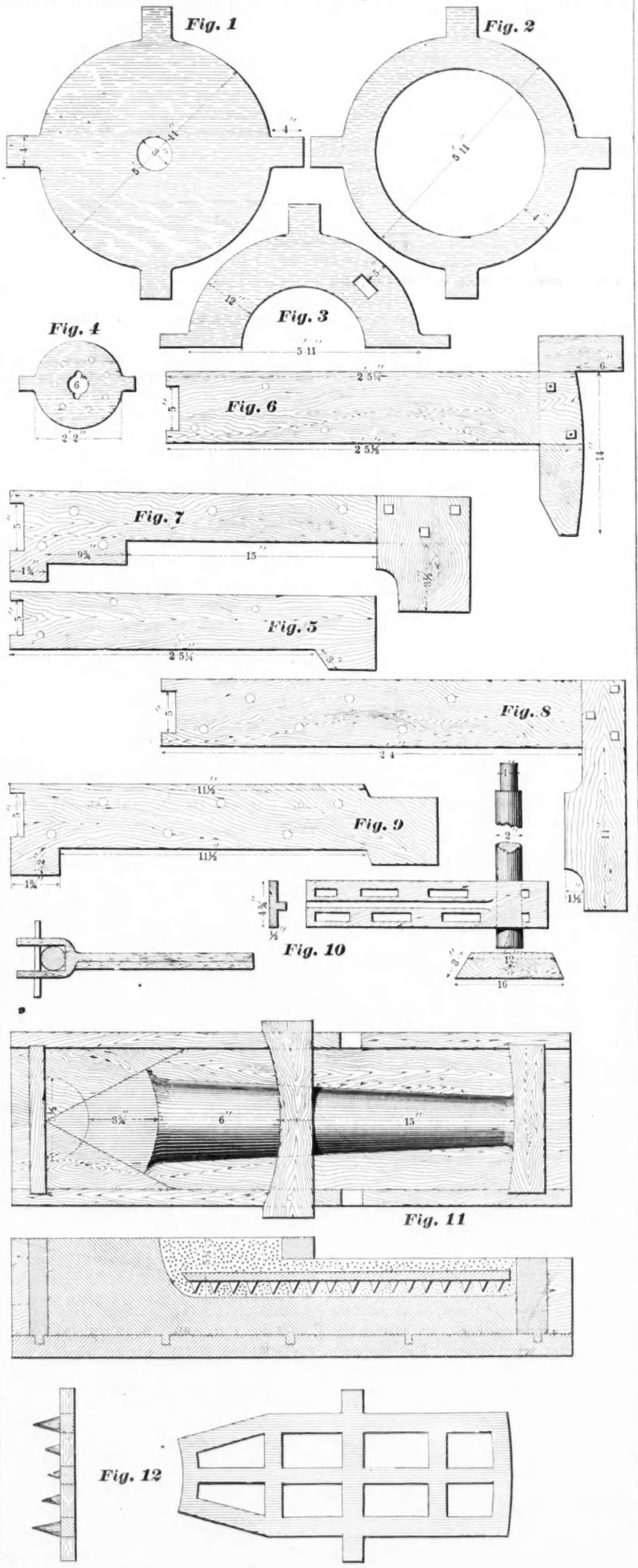
The drawings are made offhand without regard to scale, but as the sizes are all given the reader can compare them without having them repeated here. The plates and sweeps are numbered in the order in which they are used. The plates are struck up from a segment in open sand, the sizes of which can be easily obtained to suit the mould by measuring the sweeps or drawings furnished for the job.

Fig. 1 is the bottom plate, it is a plain plate, and for this piece of work is 2″ thick. This is the foundation, the base on which the whole structure rests, and ought to be heavy and strong enough not to spring when lifting the mould on or off the carriage by the lugs. Sometimes a mould is so large the bottom plate as well as the top plate is made in sections, and the mould dried in the floor or in a pit, but we may come to that class of work in the future; then we will talk about it. For the present let us go back on our floor and confine ourselves to the work we started on.

Fig. 2 is a ring 3″ deep to be used the same as the cheek of a flask for the outside of the mould. Fig. 3 is a ring plate in one piece, the same as Fig. 2, only one-half being shown here. It is 1¼″ thick, has prickers on the under side to hold the loam and is used as a covering plate for the rim of the pulley. The holes are made to come over the rim for risers and run off. Fig. 4 is a plate to cover the hub. It is 1″ thick, and also has prickers underneath. The hole in the center is made large enough to work some loam around it and let the center core come through. The holes on each side of, and forming part of the center hole, are for the pouring gate and riser. When pouring pulleys with light rims and larger diameter than this, we cast a number of holes about 12″ or 18″ apart through plate, Fig. 3, and make a basin all around over the plate and pour the pulley in the rim instead of the hub, to avoid "cold shuts."

Fig. 5 strikes up a seat for the cheek ring, Fig. 2, and the top edge of it strikes off the covering plate, Fig. 3. Fig. 6 strikes up the crown face, and the outside bearing for the rim covering plate. Fig. 7 makes the lower core print, bottom part of the hub, and seat for the arm cores. Fig. 8 forms the inside of the pulley rim and inside bearing for the rim plate. It may be noticed there is nothing on Figs. 6 or 8 to form a guide when striking up the bearing for the rim plate to close it on by (as in Fig. 9). Both joints are level, and the rim plate plain, so the guide is dispensed with. The upper edge of Fig. 9 makes a seat for the hub plate, Fig. 4, and the lower edge strikes up the hub plate and hole for the center core.

At Fig. 10 are views of step, shaft and arm; the step is a cast-iron block, with a steel pin in it for the counter-sunk end of the shaft to revolve on. The upper end of the shaft is turned to form a shoulder, and fits in a box on the end of a movable arm, which is supported from braces in the wall. A side elevation, cross-section and plan of arm are shown. These arms are of cast-iron, made in any length, and from ½″ to 1″ thick, according to length. They are keyed to the shaft. The sweep-boards are bolted to the arms through the holes shown and as the ends of the boards shown in Fig. 8 are to be placed against the shaft above and below the arm, it is an easy matter for the moulder to set the sweeps, if they are got out accurately in the pattern room. Sometimes we cast these arms with



Moulding Pulleys.

a half-box on the end, also cast a cap to suit it, and bolt them on the shaft; in either case the arm can be taken off without disturbing the shaft.

Fig. 11 is a plan of the arm core-box and longitudinal section of box, with a core rammed up, showing section of core plate represented. At Fig. 12 a cross-section of core plate is shown. These cast-iron core plates are better to strengthen a core than wrought-iron rods. In larger pulleys we have two lugs on each side of the core plate, which fit into the core-box. The half circle on the core-box is the diameter of center core. The space is the thickness of the hub. When ramming up the core, the ends of the box are clamped or screwed together, sand rammed up above the arm, the core iron clay washed and put in. The cross-piece which brings the hub end of the core up to the right depth, is then put on and the balance of the core rammed up and struck off. The cross-piece is taken off, and the bottom leveled up with green sand. Put core plate on, and tuck green sand under, good and hard, and turn core-box over; then take off clamps and bottom of core-box, and, as the rest of the pieces of the box fit together with dowel pins, they can be removed without breaking the edges of the core. Blackwash the cores with a good mineral blacking, and put them in the oven to dry. In the next article we will show the different stages of moulding the pulley.

The Republic Wreck on the Baltimore and Ohio Railroad.

We have received the following letter from the Coroner of Seneca county, Ohio:

"Tiffin, Ohio, March 18, 1887.

"*Editor American Machinist:*

"Gentlemen: Please send me a copy of your issue of March 12, 1887, containing your editorial on my verdict in relation to the Republic wreck on the Baltimore and Ohio Railroad, January 4, 1887. I am unable to procure one here, as the supply has been exhausted.

"We have no coroner's jury in Ohio. Under the statutes of this State, the coroner decides all cases.

"Yours, Ed. Lepper,
Coroner."

We are glad to be corrected by Coroner Lepper to the effect that there are no coroners' juries in Ohio; but the fact that he returned the verdict he did, without the moral support of a jury, only intensifies the credit we tried to give. Further than this it does not modify in any way the opinions we expressed at the time.

J. Starkie Gardner, in a lecture before the Society of Arts, in England, pays the following tribute to the blacksmith:

"Those who have stood by the forge, and watched the sparks fly as the skillful smith deftly beats, and twists, and combines his iron, would think it the easiest of all crafts. But who, standing by the side of the musician as he draws his bow across the chords of his violin, would realize the patient study and dexterity required before he is able to make it respond at will? As no practice or teaching can make a musician unless he have an ear for music, so can no one really excel in the manipulation of iron unless he possess special aptitude. His tools are as primitive as those of the sculptor, and with hammer and anvil, forge and bellows, a bench, a vise, and a few chisels, he has to produce out of the stubborn iron effects that may rival the work of the loom in delicacy, or form the massive entrance gates to a palace or a park."

In nearly every city in the country there is complaint of high prices for gas, and about half the State Legislatures put in time every year trying to devise means to regulate the matter. It is assumed that a city corporation should not operate gas works, although exactly why is not made very obvious. If the mains and other works were owned by the city and the supplying of gas let for a term of years to the lowest responsible bidder we believe that much of the present trouble would be overcome. This would avoid the name of making gas by the city, and give all the benefits to the users of healthy competition.

Just now there are several cities apparently anxious to let out the supplying of water to companies, and more that are sorry that they have done so. This state of repentance may always be depended upon to follow the action named.

The Cunard steamer Etruria, when she next arrives at New York, will have been altered so as to mount guns, in case of an emergency.

Those who are entitled to know predict excellent business in the building trades in New York this spring and summer.

AMERICAN MACHINIST

PUBLISHED WEEKLY

BY

American Machinist Publishing Co.

HORACE B. MILLER, Pres't.
JACKSON BAILEY, Vice-Pres't.
LYCURGUS B. MOORE, Treas. and Sec'y.
96 Fulton Street, New York.

JACKSON BAILEY, Editor. HORACE B. MILLER, Business Manager.

F. F. HEMENWAY, Mechanical Engineer.

The American News Company,
Publishers' Agents, New York.
The International News Company,
11 BOUVERIE STREET, Fleet Street, LONDON, ENG., will receive subscriptions for the AMERICAN MACHINIST, at 14/7 per annum, postage paid.

DEALERS SUPPLIED BY

The Albany News Company, Albany, N. Y.
The American News Company, New York, N. Y.
The Baltimore News Company, Baltimore, Md.
The Brooklyn News Company, Brooklyn, N. Y.
The Central News Company, Philadelphia, Pa.
The Cincinnati News Company, Cincinnati, Ohio.
The Cleveland News Company, Cleveland, Ohio.
The Colorado News Company, Denver, Colorado.
The Detroit News Company, Detroit, Mich.
The International News Company, New York, N. Y.
The Minnesota News Company, St. Paul, Minn.
The Montreal News Company, Montreal, Canada.
The National News Company, New York, N. Y.
The Newark News Company, Newark, N J.
The New England News Company, Boston, Mass.
The New Orleans News Company, New Orleans, La.
The New York News Company, New York, N. Y.
The Northern News Company, Troy, N. Y.
The Omaha News Company, Omaha, Neb.
The Pittsburgh News Company, Pittsburgh, Pa.
The Rhode Island News Company, Providence, R. I.
The San Francisco News Co., San Francisco, Cal.
The South West News Company, Kansas City, Mo.
The St. Louis News Company, St. Louis, Mo.
The Toronto News Co., Toronto, Ontario, Canada.
The Toronto News Co., Clifton, Ontario, Canada.
The Union News Company, New York, N. Y.
The Washington News Company, Washington, D. C.
The Western News Company, Chicago, Ill.
The Williamsburgh News Co., Brooklyn, E. D., N. Y.

SUBSCRIPTION.

$2.50 a year in advance, postage prepaid in the United States and Canada.
$3.50 a year to Foreign Countries, postage prepaid.

ADVERTISING.

Transient, 35c. per line, each insertion.
"Business Specials," 50c. a line.

EDITORIAL ANNOUNCEMENTS.

☞ *Positively we will neither publish anything in our reading columns for pay or in consideration of advertising patronage. Those who wish to recommend their wares to our readers can do so as fully as they choose in our advertising columns, but our editorial opinions are not for sale. We give no premiums to secure either subscribers or advertisers.*

☞ *Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.*

☞ *We are not engaged in procuring patent rights, or in selling machinery, nor have we any pet scheme to advance, or hobby to ride.*

☞ *We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

☞ *Subscribers can have the mailing address of their paper changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once.*

NEW YORK, APRIL 9, 1887.

CONTENTS.

	PAGE
Standard Section Lining for the Draftsman	1, 2
Applying for Situations	2
Promoting Firemen. By J. A. Hill	2
Literary Notes	2
Cutting Tools. By Fred. J. Miller	3
Headquarters for Master Mechanics' Convention	3
Stearns' New Bench Drill	3
A Mechanical Engineer in Politics	3
Practical Drawing. By J. G. A. Meyer. Twenty-first Paper	4
Steel or Iron	4
Appreciating a Foundry Foreman	4
Simple Forms for Strength of Materials. By C. L. Redfield	5
New Planer and Surface Gauge	5
Only a Brakeman Killed	5, 6
Letters from Practical Men—Says it Will Harden Cast-Iron. By S. Braggins—The M. M. Should Take a Trip on the Locomotive. By Bax—The Value of Steam Generating Surface. By W. H. Odell—Polishing Cylinder Heads: A Query. By Thos. Price—A Mechanical Institute in a Shop. By Geo. S. Rider	6
Heating Railway Trains by Exhaust Steam	6
Curious Tire Fracture	6
Moulding Pulleys. By Robert E. Masters	7
The Republic Wreck on the Baltimore and Ohio Railroad	7
The Moral of the Forest Hills Disaster	8
Moving to Escape Strikes	8
Questions and Answers	8, 9
Manufactures	9
Machinists' Supplies and Iron	10

The Moral of the Forest Hills Disaster.

The deplorable accident at Forest Hills, on the Boston and Providence Railroad, resulting from the failure of an iron bridge, shows that the notes of warning frequently sounded by competent engineers in regard to iron railroad bridges are not without substantial foundation. The danger is that in this particular instance criticism will be entirely directed against faulty construction and lack of periodical examination, because there appears to be abundant room for criticism in those respects.

But there is another and a much more important consideration of the question of the safety of iron bridges. Notwithstanding the disagreement of scientists, every experienced railroad mechanic has known for years that iron subjected to jar becomes crystallized in the course of time, and eventually fails without warning. This is something that inspection seldom or never reveals. Axles and other parts of locomotives fail from this cause; there is no reason to doubt that the continued hammering of passing trains will crystallize the iron of bridges, in the end making them unsafe. In the instance of locomotive and car axles experience has demonstrated that it is possible to avoid very much of the danger of breakage from crystallization by replacing them after a certain mileage, experimentally determined. This points to the conclusion that iron bridges should be similarly dealt with. It will be expensive, beyond question, but dollars and cents cannot be satisfactorily placed against human life; that is, not satisfactorily to the traveling public.

The subject is one of grave importance to railroad management, but vastly more so to the patrons of railroads. It may be cheaper for railroads to pay damages for an occasional disaster, like that at Forest Hills, than to condemn the material of a bridge after reasonable service; but in the end this is not likely to satisfy the friends of unfortunate victims of what will naturally enough be called parsimonious management. Replacing the material, or part of it, of an iron bridge when inspection does not show defects, is contrary to practice; but it is in accordance with the dictates of common sense and all experience.

Many railroad bridges were built for materially lighter traffic than that of the present. The weight of locomotives and cars has been increased, with a consequent lowering of the factor of safety. Failure of some part may under these circumstances precipitate a catastrophe that would not occur had the safety factor remained higher.

The conclusion is inevitable that railroad management cannot be safely left to deal with this question; if this is done, the consideration of cost will prevail. This is not saying that railroads are worse than other corporations, or worse than individuals, in this respect. It is found necessary to regulate a thousand things by law, where it might be supposed that self-interest or some regard for humanity would be sufficient. There is now some effort at State inspection of railroad bridges, but it amounts to nothing except by name. This inspection should be rigid and uncompromising. It should take account not only of construction and apparent condition, but of the length of time the metal has been hammered along towards a state of weakness. Moreover the inspections should be made by competent civil engineers, not by political engineers.

If nothing comes—as appears to be probable—of the Forest Hills killing except the cheap denunciation of the railroad management responsible for it, denunciation that, if accounts are true, is altogether righteous, the lesson learned will be practically useless. It is likely, but not creditable, that a few more bridges must go down before it will be learned that it is unwise to permit railroad corporations to gamble on the probability of failure, betting the probability of failure against the cost of renewal. If, somehow, the railroad management were compelled to stake life against life the game would be fairer, and it may be added there would be fewer bridge failures on railroads.

Moving to Escape Strikes.

Bonuses have begun to clash with bonuses in attracting manufactories. A town in Maine is willing to put up $75,000, or its equivalent, to get a shoe factory to locate within its borders. A town in Vermont that wants the same factory, proposes to erect a factory building, move the machinery, and guarantee exemption from taxation for ten years. Other places are also making offers which seem as good, if not better, and the town where the shoe shop is now located is yet to be heard from. Some towns claim exemption from the control of strikers. We would earnestly suggest to people in such free places that before they give any sort of a promise that strikes will not occur, they require some guaranty from the party accepting the bonus that reasonable wages will be paid, and that their fellow citizens who work in the new factory be treated in a fair and equitable manner, and not as mere automatic machines used in production. It would be a wise precaution to require such a guaranty from any concern moving for the sake of avoiding strikes and taking a bonus, for it may safely be assumed that where strikes occur, the fault is not always on the part of the strikers. Of course there is no need to ask such a guaranty from parties whose controlling motives in moving do not include a prospective freedom from strikes.

Cheap and Dear Natural Gas.

The problem of economizing in industrial operations by using natural gas instead of coal is not old, but now comes a corollary to the original problem, which claims earnest attention. The natural gas wells in Pittsburgh and vicinity have been pretty well absorbed by a syndicate and the price fixed without local competition of any visible magnitude. Still, in comparing natural gas against coal the economy shows well in favor of the former. Other and smaller towns in Ohio, Michigan, Pennsylvania and elsewhere have been discovering natural gas and don't sell it at as high a price as the syndicate. One glass manufacturer, for instance, moved from Pittsburgh to Findlay, Ohio, got his natural gas at the latter place as well as he had been getting it in the former, and claims to have saved $2,700 a year over the Pittsburgh gas. The saving over coal for the same work was $6,000.

Findlay and a lot of other small towns east of the Mississippi seem to have plenty and to spare of natural gas, and manufacturers can estimate upon the probable economy of locating in those towns.

J. A. Hill gives some original views on promoting firemen in this week's issue. Mr. Hill is an experienced locomotive engineer with remarkable observing powers. He believes in railway service reform, but not of the kind that ties up the appointing and removing power with a set of Procrustean rules. On most roads it would doubtless be an improvement to give more attention to the promotion of firemen, and if additional supervisory talent is needed to assist, let it be engaged.

The adoption of a standard system of section lining for draftsmen is of more importance than some other proposed standards that have been more widely discussed. We are indebted to Dr. R. H. Thurston, director of Sibley College, Cornell University, for the drawings and data from which the cuts and article on our first page this week were prepared. The system of section lining, as adopted at that institution, under the direction of Dr. Thurston, will be interesting and suggestive in every drafting room. If something of the kind could be universally adopted, it would help laymen to read drawings where they are now often at fault. Perhaps the benefit to draftsmen would be even greater than to unprofessionals.

A Hint to American Woolen Manufacturers.

Our American woolen manufacturers should not be slower than foreign manufacturers to appreciate the extent of the demand that can be built up in this country for woolen garments and bedding. To make such articles popular they must be made of absolutely pure wool, and confidently known to be such by purchasers, while they should be so finely woven as to be agreeable to the wearer or user day or night, summer or winter. If foreign wools are required for this purpose, the duty on imported woolens should at least offset the duty on the imported wool used.

Flannel garments are now largely used by athletes, firemen, and others, who are called upon to engage in vigorous physical exercise likely to cause profuse perspiration, or are exposed to sudden and severe changes of temperature. But the great majority of people still need to have the advantages of pure wool for all the purposes of ordinary use, and for many purposes not heretofore thought of in connection with the fabrics mainly employed, clearly and confidently demonstrated. Among advantages claimed for it if properly utilized, are substantial non-conductivity to heat and electricity, and permeability to moisture, protecting the wearer or sleeper from the effects of oppressive heat in summer and maintaining a proper degree of heat in winter, without discomfort, if the garments or bedding are of the requisite degree of fineness and purity. We have reasons for believing this a subject to which American woolen manufacturers should give special attention.

Questions and Answers.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(154) E. E. S., New York, will find in the store of any dealer in small machinists' tools, micrometer calipers or gauges, by which he can measure to the thousandth of an inch.

(155) H. C., Los Angeles, Cal., asks: If a boiler is half full of water, and air is forced in at the bottom, will the air rise through the water if steam is at high pressure? *A.*—Yes.

(156) J. F., Syracuse, N. Y., asks: 1. How can I find gears to cut any thread when the index does not give it? *A.*—In the AMERICAN MACHINIST, August 13 and 20, and October 15, 1881, you will find this fully explained.

(157) J. B., Kansas City, Mo., asks: Is there a premium offered for a machine to navigate the air in any direction, regardless of the wind? *A.*—We are not aware that any one has offered a premium for such a machine.

(158) G. M., Chicago, Ill., asks: Is there a formula for finding the volume of steam at any pressure? *A.*—Consult any engineers' pocket-book; you will also find tables of steam that will save calculations, and be much more satisfactory generally.

(159) A. R., Manistee, Wis., asks: Which side of a belt—the finished or the unfinished side—should run next the pulley? *A.*—There is yet difference of opinion on this subject; the burden of opinion is that what you call the finished side should be next the pulley.

(160) J. W., Columbus, Ohio, can make a waterproof glue, used for uniting almost any substances together, by dissolving in ether free from alcohol, and in separate vessels, three parts, by weight, of gum shellac and one part caoutchouc. In dissolving apply gentle heat. When the two substances are thoroughly dissolved, mix the two solutions, and keep in a bottle closely stopped.

(161) J. P., Brooklyn, N. Y., asks: How can I tin small cast-iron pieces? *A.*—Thoroughly cleanse the articles to be tinned, and immerse in a bath of one ounce cream of tartar, one ounce protochloride of tin, and ten quarts of water. The bath should be kept at a temperature of 190° in a stone vessel. Pieces of zinc should be thrown into the bath.

(162) C. D., Dubuque, Iowa, asks: Why can the tubes in a vertical boiler be partially exposed to the heat from the furnace, while in horizontal boilers they must always be covered? *A.*—In upright boilers that part of the tubes nearest

the fire is covered with water, and the heat is taken up so quickly that by the time the gases get above the water line they are not hot enough to do serious damage.

(163) P. T., Copalquin, Durango, Mexico, asks: Can I use a condenser to advantage without an air pump? The injection water has 10 feet head, and the end of discharge pipe can be 40 feet below condenser if required. Will the flow of water through condenser carry the air with it so as to maintain a vacuum? If so, what vacuum can I expect? *A.*—You cannot use an ordinary condenser in the way you mention. There are condensers made specially for the purpose, which, if put up and piped according to directions, will work without air pump, giving as good vacuum as is had with a pump. These condensers are patented devices.

(164) A. C., Prato, Italy, asks: Will you tell me how the pin of the crosshead shown on page 2 of the AMERICAN MACHINIST of February 12 is turned? *A.*—One way in which they are turned is to center the crosshead on the line *f K*, exactly as for any piece to be turned in the lathe. Mount between the lathe centers, but do not dog. Then put a lever in the hole for rod, start up the lathe to drive the feed, and swing the crosshead back and forth by hand. In this way one-half the circumference of the pin may be turned; then, by reversing the crosshead between the centers, the other half may be turned. Of course, machinery could be devised to do this more easily.

(165) W. J. G., Baton Rouge, La., writes: A boiler was inspected which had a 4-inch safety valve. The valve was in good condition, with ample room for expansion, and was set for 100 lbs. steam pressure, and worked to perfection. When water pressure was applied, it lifted at 80 lbs. by three gauges placed on different parts of the boiler. Steam was then raised, and the valve again blew at 100 lbs. Why did the valve raise at less water pressure? *A.*—We cannot tell. Possibly there was some springing with the water pressure that kept the inside of the ground joint away from the seat, thus giving the pressure a greater area upon which to act than that of the opening.

(166) J. F. B., Carbondale, Penn., asks: 1. Should a globe valve be so placed that the pressure will come on top or underneath it when closed? *A.*—The custom is to place it so the pressure will be underneath, because the packing will last longer, and because the stem can be packed with steam in the pipes. 2. Should the piston of an engine travel over the counterbore of the cylinder at each end? *A.*—Yes. 3. How is the tensile strength of the iron in a boiler found? *A.*—By testing specimens before the sheets are worked up. 4. How is iron or steel chilled? *A.*—By casting it against a chill, usually made of cast-iron; this cools the metal quickly and hardens it.

(167) T. W. R., Bradford, Pa., asks: Are the back gears of a lathe for the purpose of increasing the power, or a convenient way of changing the speed? A lathe with four steps to the cone and back-geared gives eight changes of speed. Would not a cone with eight steps, properly proportioned, give the same power? *A.*—It is a question of belt speed and the speed of the work at the cutting surface. If you could use pulleys large enough to give the required belt speed, you could do away with back gears. But it is entirely impracticable to do so, as you will see by a little reflection. Lengthening the cone pulley to the extent indicated would also be impracticable.

(168) A. S., Noel, Iowa, asks: 1. What should be the dimensions of ports and valves for an engine 2"x2¾"; to run at 400 revolutions with 85 pounds steam pressure? *A.*—You can make steam ports 3-16"x1"; exhaust port, ⅜"x1"; outside lap of valve, 3-16"; inside lap, 0; travel of valve, ¾ inch. 2. What would be the power of such an engine? *A.*—About ½ horse power. 3. How large an upright boiler would be required for such an engine? *A.*—Make a boiler with 8 feet of heating surface. 4. What should be the diameter of crank shaft? *A.*—One inch. 5. What should be the weight and width of face of a 7-inch pulley, also used as a fly-wheel? *A.*—Wheel ought to weigh from 20 to 25 lbs.; this will give plenty of width for belt.

(169) Engineer, Hantsport, N. S., writes: Please inform me how much heating surface in a tubular or locomotive boiler is required to produce a given volume of steam per minute at a given pressure. For instance, I require 542,400 cubic inches of steam per minute at 100 lbs. to run a certain engine. How much heating surface would be required with forced blast, and how much more with natural draft to produce said volume of steam? *A.*—In locomotive boilers in which a forced blast is used one square foot of heating surface will give 44 cubic feet of steam at 100 lbs. pressure per hour. In good-proportioned tubular boilers with natural draft one square foot of heating surface will give 23 cubic feet of steam at 100 lbs. pressure per hour. Taking these figures as a guide, we can find the amount of heating surface required to produce 542,400 cubic inches of steam per minute. In even figures, 542,400 cubic inches is equal to 314 cubic feet; and 314×60=18840 cubic feet of steam required per hour. 18840÷44=428 square feet of heating surface required to produce 314 cubic feet of steam per minute when a blast is used. 18840÷23=819 square feet of heating surface required to produce 314 cubic feet of steam at 100 lbs. pressure per minute when a natural draft is used.

(170) W. A. S., Boston, Mass., writes: 1. What is Kalamein iron? Would it injure water for drinking purposes? Is the process patented? *A.*—Kalamein is the formation of an indestructible alloy, produced by the complete amalgamation of several non-corrosive metals. Its action upon iron is so positive as to fill every pore, embodying itself into and becoming practically part and parcel of the iron. In appearance it is of a silvery color, resembling galvanized pipe, but without the spangles. It is recommended for gas and water-service pipe; in fact, for all work which requires a metal to resist the action of the atmosphere. It is patented; the National Tube Works Company, McKeesport, Pa., are the sole manufacturers in the United States. 2. Given a short piece of straight pipe, ¾" diameter, connected directly to a large supply pipe; pressure, 42 lbs.; time to deliver 10 cubic feet, 1 minute and 22 seconds, what time would it require to deliver 10 cubic feet under like conditions, pressure being 75 lbs? Also pressure being 100 lbs? What is the rule? *A.*—In order to answer these questions, the length of the pipe and kind of pipe should have been given. The following rule will give an approximate result. First find the velocity:

$$\text{Vel. in feet per second} = 48 \times \sqrt{\frac{\text{Diam. in feet} \times \text{total head in feet.}}{\text{Total length in feet} + 54 \text{ diam. in feet.}}}$$

In this rule the number 48 is a constant number, and the total height in feet is that due to the pressure. To find the time in which 10 cubic feet will be discharged, divide the 10 cubic feet by the product of the area of the pipe in feet by the velocity in feet per second; the quotient will be the number of seconds required. 3. If a boiler or tank 1 foot in diameter, iron ¼ of an inch thick, would burst at 100 lbs., would not 4 or 5 feet in diameter, same thickness of iron, burst at much lower pressure? Heads supposed to be made heavy enough. *A.*—Yes; the bursting pressure will be inversely as the diameters.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

Gear Wheels. See Geo. B. Grant's adv., page 16.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Edw. Sears, Wood Engraver, 169 William st., N.Y.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

J. Clayton, Air Compressors, Rock Drills, 43 Dey st, NY

Extra capacity, hollow-spindle Hand Lathes; correspondence solicited. J. R. Rand, Brattleboro, Vt.

Light articles built to order by the American Sewing Machine Co., Philadelphia, Pa.

The Best Upright Hammers run by belt are made by W. P. Duncan & Co., Bellefonte, Pa.

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

Solid Nickel-Seated "Pop" Safety Valves. Consolidated Safety Valve Co., 111 Liberty st., N. Y.

Robbs' Patent Composition for case-hardening send for circular. F. W. Tasney, Paterson, N. J.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Davis Key-Seating Machines, kept in stock, by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

20", 25," 28" B.G. and S. F. upright drills for immediate delivery. Currier & Snyder, Worcester, Mass.

Ice and Refrigerating Machines. 120 built, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

Selden Packing, for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y

Drawing Materials, all kinds. Get catalogue. Mention this paper. G. S. Woolman, 116 Fulton st., N. Y.

Light articles, special machinery, punches and dies, & press work to order, F. E. Bright, Cleveland, O.

The Improved Tabor Steam Engine Indicator, made and sold by The Ashcroft Mfg. Co., 111 Liberty st., N. Y.

Engine Lathes, Hand Lathes, and other fine tools. Assortment large; prices low. Frasse & Co., 92 Park row, N. Y.

Curtis Pressure Regulators, Curtis Return Trap, Curtis Damper Regulator. See Mch. 26, p. 13. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

Machinists' supplies, brass goods, m'f'rs' supplies, polishing materials, all kinds wire, metals, etc.; in any quantity. Jordan & Gottfried, 208 Canal st., N.Y.

For Best Return Steam Traps, Pressure Regulators, Positive-Acting Pump Govs., Back-Pressure Valves. T. Kieley, 11 W. 13th st., N.Y. Send for des'n.

Practical Handbook on Pump Construction. Various kinds and materials to be made of for different purposes. By P. R. Bjorling. Nine plates, 12mo., $1.50. E. & F. N. Spon, publishers, 35 Murray street, New York.

New Book on Gears; Tables giving 3,094 diameters, with rules for calculation of movements of shafts, etc.; sent on receipt of P. O. Note; price 50 cts. Address C. B. Long, M. E., Worcester, Mass.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines, and current practice in testing engines and boilers. Price, $2 post-paid. Published by John Wiley & Sons, 15 Astor Place, New York.

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, the full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G CO., 96 Fulton st., New York.

MANUFACTURES.

The Buckhannon Boiler Works are to be erected at Calera, Ala.

The Cotton Novelty Works, Galesburg, Ill., are crowded with work.

Stock has been subscribed for a $50,000 cotton mill at Fort Smith, Ark.

All the money has been subscribed for the proposed silk mill at Emaus, Pa.

The Sioux City (Ia.) Tub and Barrel Factory is to be enlarged $8,000 worth.

$16,000 have been subscribed towards erecting the cotton mill at Tuscaloosa, Ala.

Mrs. J. M. Noble, of Chicago, will build a four-story factory, 50x135 feet, at 1601 Clark street.

J. A. Prigden, M. C. Fields and others are thinking of building a cotton factory at Kinston, N. C.

J. & J. Titley, Chicago, Ill., will erect, at 114 Arbor Place, a three-story factory, to cost $20,000.

Montpelier, Vt., has voted to exempt all new manufactories from taxation for a term of years.

A new worsted mill is contemplated at Tacony, on the Delaware River, the largest in the country.

W. H. Hassinger and others, of New Orleans, La., talk of erecting a rolling mill at Birmingham, Ala.

Mr. Ransom and others are organizing a company at Winchester, Tenn., to build a cotton factory.

J. W. Tufts, of Boston, will erect a six-story manufacturing building at 100 Portland street, 62x74 feet.

W. G. Solomon and others are forming a company at Macon, Ga., to assist in starting new enterprises.

William Craig is erecting machinery at Knoxville, to manufacture shoes. Will invest about $12,000.

Thos. P. Rhodes, of Philadelphia, will erect a three-story brick factory at York street and Sedgley avenue.

The Lawrence Boiler Works, Lawrence, Mass., are adding a new riveting shop with complete machinery.

Pfeiffer & Lavenburg will erect a color work factory on North Eleventh street, Brooklyn, N. Y. to cost $6,000.

Pittston, Me., people are raising a bonus to induce a large shoe manufactory in Massachusetts to move there.

Work in the Frost & Co. shops, Galesburg, Ill., is booming. This company have large orders for work from the West.

The cotton factory company has been organized at Columbus, Miss., with H. Johnson as president. They will build at once.

M. Groh & Sons, of New York city, will erect a six-story brewery at 242 West 28th street. It will be 52x48 feet, and cost $50,000.

Barton & Smith, Anderson, S. C., contemplate locating their planing mill at some other place in the South, but have not yet decided where.

Mr. Kinney, late of Andover, N. B., has decided to establish a large tannery at Presque Isle, Me., if sufficient encouragement is given by the citizens.

Darling Brothers, of Rochdale, Mass., contractors and builders, have been awarded a $10,000 contract for building the Chaplain Brass Foundry at Indian Orchard.

T. J. Lattner & Co., Chattanooga, Tenn., recently reported as erecting a tack factory, contemplate, within six months, erecting a steel plant and rolling mill.

W. A. Jones, of the Jones Street Car Manufactory, of West Troy, N.Y., is interested in the building of a large manufacturing establishment at East Saginaw, Mich.

A shoe factory, employing 150 operatives, has been induced to move from Pittsfield, Mass., to Calais, Me. It will start up the 1st of May in the latter place.

The Red River Land Company, New Orleans, La., has organized with W. J. Behan as president; it will erect a factory at Natchitoches to prepare cotton seed for exporting.

The Gate City Land Co.—capital stock, $600,000—has been incorporated at Birmingham, Ala., to start a manufacturing town about five miles from Birmingham. Fred. Sloss is interested.

Work in the G. W. Brown & Co. Corn Planter Works, Galesburg, Ill., is rushing. The men are working twelve hours per day in some of the departments. They are taking off two casts a day in the foundry.

The steel manufacturing industries of Syracuse, N. Y., are to be materially increased. There is a contemplated improvement at the Sanderson Steel Works which will involve an expenditure of more than $100,000.

The citizens of Greenfield, Mass., are opening their pocket-books to raise $600 bonus to induce Emil Weisbrod to remove his pocket-book factory from Montague to that place. He expects to employ 50 hands after he moves.

James H. Pratt, of Albany, N. Y., is at the head of a new company, which will erect a horseshoe nail factory in West Troy. Ground for the works has been secured. The machine used is the invention of David Williams, of Plattsburgh.

The Pittsfield Manufacturing Company has been incorporated to do business at Pittsfield, Mass., with a capital of $12,000. The officers are James O. Purnell, president; W. T. Petherbridge, treasurer; the same and Edward Slugg, directors.

The South Side glass-workers, Pittsburgh, Pa., who propose to start a co-operative works at Des Moines, Ia., have elected G. W. Wilkinson manager. One Saturday recently twenty-seven members paid down $100 each as their first assessment.

The Mark car coupler pattern shops at Flint, Mich., will be removed to Cleveland, O., unless the citizens raise a bonus of $40,000, in which event Mr. Mark will put 200 men at work at once, and will increase the number to 1,000 in a year.

The Rome Iron Land and Improvement Company has been incorporated at Rome, Ga., by J. L. Bass, W. P. Simpson, John H. Reynolds and others, with $6,000,000 capital. The object of the company is to aid in starting new manufacturing and mining enterprises.

James Brandon has established himself in business at 390 Eleventh avenue, New York. He will do a general jobbing machine business, and will also manufacture his patent packing for cylinders of steam engines, pumps, and for all purposes where fluid pressure is used.

Samuel T. Williams, 447 North street, Baltimore, Md., writes us: "Since first of year business has picked up, and we were very busy last month. Inquiries have been numerous for engines. I have just received an order for one 25 horse-power engine, and am now putting up several 6 horse-power upright engines."

Miles & Horne, Grant Wilkins and a gentleman from Toledo, O., have effected the organization of a company to operate the old Atlanta Iron Bridge Works, Atlanta, Ga., and to manufacture the Brasins patent axle. The company will be known as the Atlanta Bridge and Axle Company. The capital is $150,000. New machinery will be put into the works.

Among the larger works which it is reported will be commenced in Wichita, Kan., within a few weeks, are the Burster Architectural Iron Works, the Franklin Architectural Iron Works, the Wichita Rapid Transit Company's street car line, besides the proposed paper mills, packing houses, glass factory, artificial stone works, starch works, brick works, cement work, etc.

Sterling Elliott, of Newton, Mass., has issued a neat pea-green covered catalogue and price-list of drill presses, cutting-off tools, centering attachments, and tap drill gauges made by him. These articles are well described by aid of cuts. Mr. Elliott describes, in his inimitable style, how he came to make a drill press that will do a wide range of light work. He has lately improved it.

The Decatur Iron Bridge Construction Company—capital stock, $100,000—has been chartered at Decatur, Ala., to build bridge works, with George S. Moor, of Birmingham, as president; R. W. Curtis, Chicago, vice-president and general manager; and E. D. Ormstead, Birmingham, secretary and treasurer. Work has been commenced. Their main building will be 240x300 feet.—*Baltimore Manufacturers' Record.*

The Buckeye Engine Company, Salem, Ohio, has issued a new illustrated catalogue of the three styles of engine built at the works. The catalogues of this company are always got up in the best style, with first-class engravings, and are interesting and instructive. This one is no exception. It contains illustrations and reading matter not before presented in the company's catalogue. Under a separate cover is a long list of the names of parties using "Buckeye" engines.

The Mason Regulator Company, of Boston, write us: "Our business is very brisk this month. We have sold our reducing valves for car heating. We have also sold a number to the Hyatt Water Filter Company for reducing water pressure; also the Franklin Sugar Refinery, of Philadelphia; the Bay State and Standard sugar refineries, of Boston. Of our pump pressure regulators we have recently sold several to Foskett & Bishop, of New Haven, for use in connection with the Grinnell fire sprinkler system; also to the Deane and Blake Pump Companies and B. C. Mudge, of Boston.

A contract, representing over a quarter of a million of dollars for machinery alone, was signed March 17th by W. W. Smith, president; John H. Valle, vice-president; and O. M. Gottshall, counsel, representing the Smith & Valle Company, of Dayton, O., and Henry C. Butcher, president; Frederick Oliver and Daniel A. Tompkins, of Charlotte, N. C. the Executive Committee, as the representatives of the Southern Cotton-Seed Oil Company, recently organized in New Jersey. The contract calls for the construction of the press-room machinery for eight cotton-seed oil mills, of a capacity of 150 tons per day each, and the exact price stipulated is $266,000. All of this machinery, as well as 256 linters and 20 hulling machines, contracted for with the Carver Cotton Gin Company, of East Bridgewater, Mass., is to be ready and delivered in time to work up the coming season's crop. The contract with the Smith & Valle Company carries with it all the patents on this kind of machinery now owned by that company, and this, it is said, gives the Southern Cotton-Seed Oil Company the practical control of all machinery by which cotton-seed oil is made under the new and improved process. The mills are to be erected at different points, so as to cover the entire cotton belt, and also insure to the company an unlimited supply of the seed, of which there is annually produced about 3,000,000 tons, and only about 400,000 tons have heretofore been reduced to oil, the balance having in recent years been used for fertilizing purposes.

Machinists' Supplies and Iron.

NEW YORK, March 23, 1887.

Iron—There is no change in prices for American pig. Quotations are: No. 1 X Foundry, $21 to $22; No. 2 X, $20 to $22.50; Grey Forge, $18 to $18.50.

Scotch Pig—Nothing but small transactions in Scotch brands. We quote: Gartsherrie, $22 to $22.50; Summerlee, $22.50 to $23; Eglinton, $21; Langloan, $21.50 to $22; Dalmellington, $20.50 to $21.

✲WANTED✲

"Situation and Help" advertisements only inserted under this head. Rate, 3c. cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

Wanted — An industrious, capable machinist. Address X. P. O., Box 2, Wilmington, Del.

A man with theoret. and practical experience wishes situation as designer or foreman of drawing room. Address M. E., AM. MACHINIST.

Wanted—Situation as foreman by an energetic man well posted in modern machine shop practice. Address 244, AM. MACHINIST.

Wanted—Position in office of machine shop; knowledge of machinery, fittings, etc., and can make rough drawings. Address Mich., AM. MACH

Wanted—A competent Draftsman; one acquainted with printing machinery preferred Address, stating age, experience and salary expected, Box H, Plainfield, N. J.

Wanted—A salesman would like to make arrangements with an A 1 house to trade on steam goods; has 12 years' experience; East or West. Address Box 17, AM. MACHINIST.

Wanted—Situation as foreman of machine shop; experienced in building automatic engines, etc.; first-class references. Address High Pressure, AM. MACHINIST.

Wanted—A competent foreman boilermaker to take charge of a large shop, manufacturing portable, stationary and marine boilers. Address Roberts, care AM. MACHINIST.

Wanted—A first-class reliable salesman to sell a line of first-class machinery; none but successful salesmen need apply. Address, stating experience and salary expected, X. Y. Z., care of AM. MACH.

Mech. draftsman wants position; used to make show drawings, full-shaded, water colors or pen and ink; quick sketcher. Address S. P. O., Box 373, Philadelphia, Pa.

Wanted—By young man, position as assistant draftsman; has practical knowledge of machine construction and good abilities; small shop preferred. Address Practical, AM. MACHINIST.

A machine foreman, designer and draftsman with experience managing men and shop manufacturing fine tools and interchangeable machinery, wishes to correspond with parties in need of such a man. Address G. W. N., Box 45, Ridley Park, Pa.

Wanted—A foreman patternmaker in a locomotive works West; none but a man thoroughly competent to fill position of foreman need apply; state age, wages expected and previous experience. Address Locomotive, AM. MACHINIST.

Foreman patternmaker wanted; a capable and reliable man to take charge of a pattern shop, by an establishment located near New York; a permanent situation and good wages to the right man. Apply by letter to F. F. Hemenway, AM. MACHINIST, 96 Fulton st., New York.

Wanted immediately—One mechanical draftsman, thoroughly familiar with the details of iron mill-work; one young man to make tracings and two or three first-class patternmakers for general work; reply, with reference, and state when can come and compensation expected. Address Riverside Iron Works, Wheeling, W. Va.

Foreman wanted; experienced, first-class machinist, thoroughly familiar with modern tools and appliances, to superintend the construction of high-speed automatic engines; must have ten to fifteen thousand cash to take an interest in well-established and profitable business. Address Box 18, AM. MACHINIST.

A reliable mechanical engineer and draftsman of 25 years' practice, experienced in stationary steam engines, non-condensing, condensing and compound, boilers, tools, mill-work, hydraulic machinery, pumps, also in the general management of works and direction of men, desires a position with a reliable firm as superintendent or a partnership, where ability and good practice will in a measure offset capital; South or West preferred; unexceptionable reference. Address Experto Crede., AM. MACHINIST.

✢ MISCELLANEOUS WANTS. ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Crescent solid lubricant, clean, durable, cheap; prevents hot boxes. Crescent Mfg. Co., Cleveland.

The Crescent automatic grease cup is adapted to every service. Crescent Mfg. Co., Cleveland, Ohio.

Light mach'y of all kinds built at short notice Edmund Mills, 8 Dey st., Jersey City Heights, N. J.

For Sale—One set of Niles pulley machinery as good as new. Address Frick Co., Waynesboro, Pa.

Special tools and machines for mfg. designed and built to order; mechanical and Patent Office drawings. I. A. Weston & Co., Syracuse, N. Y.

For Sale—One 1⅛" Merriman bolt-cutter, one 20" swing, 12 ft. bed, engine lathe, both new. The McLagon Foundry Co., New Haven, Ct.

For Sale—One Lathe, 28" swing, 20 feet between centers; one jig saw, one wood-turners' lathe. A. L. Henderer, Wilmington, Del.

For Sale—Second-hand 5x14" Monitor, 5-16" Fox Lathes. N. Y. Machinery Depot, 16 Bridge Stores, N. Y.

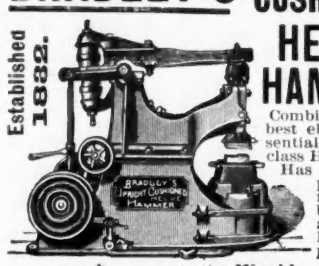
For Sale—Low figure, in good order, four stationary engines—one each of thirty-five, forty, fifty and sixty horse-power. Address Pratt & Letchworth, Buffalo, N. Y.

For Sale—Milling machines, drill presses, screw machines, cam machines, tapping machines, planers, lathes, etc.; send for circular. E. Parmly, Treas. the New Howe Manufacturing Co., Bridgeport, Conn.

For Sale—One 28 swing, 12-bed Fifield Engine Lathe, complete; raised on blocks to swing 37"; new 18 months ago; first-class order. The Powell Planer Co., Worcester, Mass.

Boilershop tools wanted—One steam riveter, 6-foot post; one plate planer, 16½ ft.; one punch, 36 inch reach, with spacing table; one set of 16-foot bending rolls; one horizontal flange punch. Above tools must be heavy and first-class; may be new or second-hand; give price and full particulars. Address Frick Co., Waynesboro, Pa.

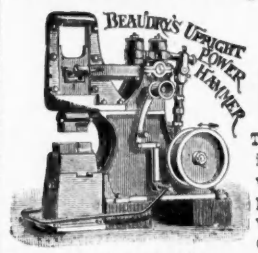
BRADLEY'S UPRIGHT CUSHIONED HELVE HAMMER



Combines all the best elements essential in a first-class Hammer. Has more good points, does more and better work and costs less for repairs than any other Hammer in the World.

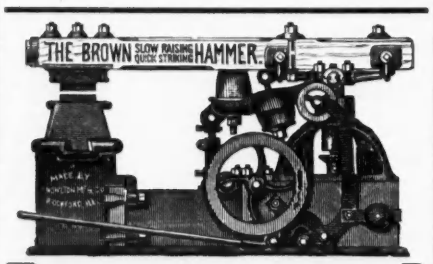
BRADLEY & CO. Syracuse, N.Y.

BEAUDRY'S UPRIGHT CUSHIONED POWER HAMMER



The success of our machine is the best guarantee of its value. Only hammer with patent Duplex Steel Helve which never rattles, burns or breaks. Guaranteed to do more and better work with less repairs than any other.

BEAUDRY & CUNNINGHAM, Boston, Mass.



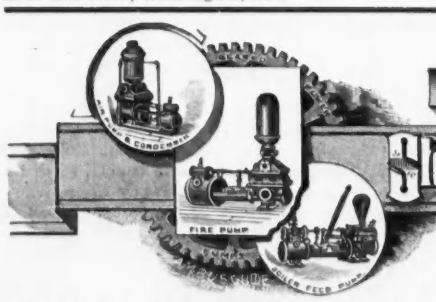
THE BROWN HAMMER STRIKES A BLOW WITH Double the Velocity That it Raises the Hammer. A NEW MOVEMENT! SEND FOR DESCRIPTION. KNOWLTON MFG. CO., KING ST., ROCKFORD, ILL.

STEPHENS PATENT VISES.

ONE-HALF TIME and LABOR saved by using this solid, strong, durable, firm-hold, quick working Lever (Not Screw) Vise. Has improved Taper-Pipe and other attachments. Sold by the trade. Send for circular

TOWER & LYON, 95 Chambers Street, New York. Successors to MELVIN STEPHENS.

KNOWLES Steam Pump Works.

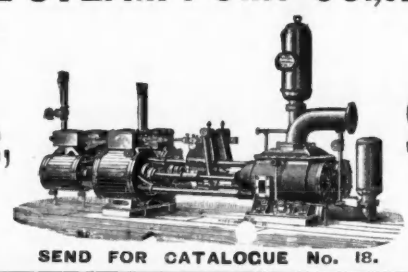


93 Liberty St. NEW YORK. | 44 Washington St. BOSTON.

IMPROVED PUMPING MACHINERY | For Every Class of Work | SEND FOR NEW ILLUSTRATED CATALOGUE.

THE DEANE STEAM PUMP CO., Holyoke, Mass.

BUILD Water Works, ENGINES AND Steam Pumping MACHINERY.



SEND FOR CATALOGUE No. 18.

TRAVERSE SHAPERS.

15 inch stroke x 27 inch Traverse.
20 " " x 60 " "
30 " " x 72 " "

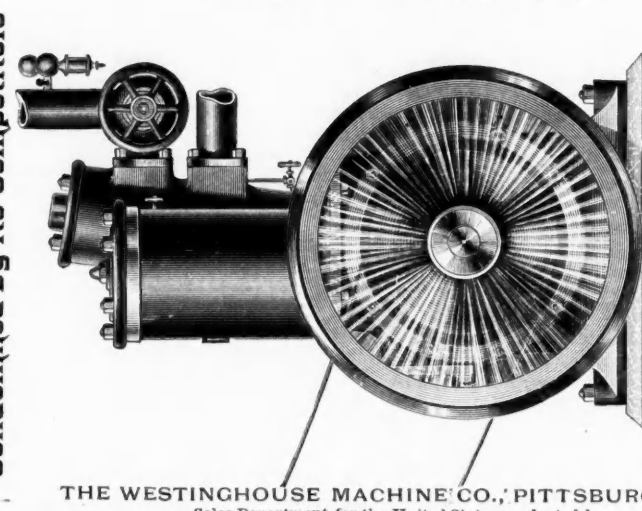
As noted above, we build 3 sizes of Traverse Shapers and can make the beds any desired length to suit special work. They are all stiff solid tools with a very deep bed. The two larger sizes have each 2 tables, a large heavy graduated swivel vise and automatic, vertical, angular and horizontal feed. The circular arbor also has independent feed. Screws and shafts are of steel and bearings are of hard bronze. The rack gear and pinion and other small gears are of steel. Our illustrated catalogue gives full description, and we shall be pleased to send them to those who are interested.

THE HENDEY MACHINE CO., TORRINGTON, CONN.

THE WESTINGHOUSE AUTOMATIC ENGINE.

Prices Reduced.

Condemned by its Competitors



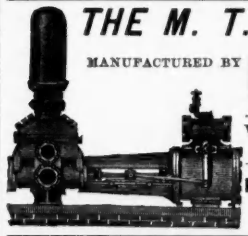
and Endorsed by its Users.

THE WESTINGHOUSE MACHINE CO., PITTSBURGH, PA.

Sales Department for the United States conducted by

WESTINGHOUSE, CHURCH, KERR & Co., 17 Cortlandt St., N. Y.
FAIRBANKS, MORSE & CO., Chicago, Ill. Hamilton Building Pittsburgh, Pa.
FAIRBANKS & CO., St. Louis, Mo.
PARKE & LACY, San Francisco, Cal.
UTAH & MONTANA MACHINERY CO., Salt Lake, Utah.
D. A. TOMPKINS & CO., Charlotte, N. C.
ROBERT MIDDLETON, Mobile, Ala.
H. DUDLEY COLEMAN, New Orleans, La.
KEATING IMPLEMENT & MACHINE CO., Dallas, Tex.
IRON BAY MANUFACTURING CO., Marquette, Mich.

THE M. T. DAVIDSON IMPROVED STEAM PUMP,



MANUFACTURED BY DAVIDSON STEAM PUMP COMPANY.

WARRANTED THE BEST PUMP MADE FOR ALL SITUATIONS.

PRINCIPAL OFFICE, No. 77 LIBERTY STREET, N. Y.

NEW ENGLAND OFFICE, 51 OLIVER STREET, BOSTON, MASS.

SEBASTIAN, MAY & CO.'S Improved Screw Cutting FOOT or POWER LATHES.

Catalogue of Lathes, Drill Presses and Machinists Tools and Supplies mailed on application. *Lathes on Trial.*

167 W. Second St., CINCINNATI, O.

W. C. YOUNG & CO., Worcester, Mass. Manufacturers of Engine Lathes, Hand Lathes, FOOT POWER LATHES, SLIDE RESTS, Etc.

"THE SWEETLAND" CHUCK M'F'R'D BY THE HOGGSON & PETTIS M'F'G CO. EST. 1849 NEW HAVEN, CT.

GUILD & GARRISON, BROOKLYN, N. Y. STEAM PUMPS, VACUUM PUMPS, AIR COMPRESSORS.

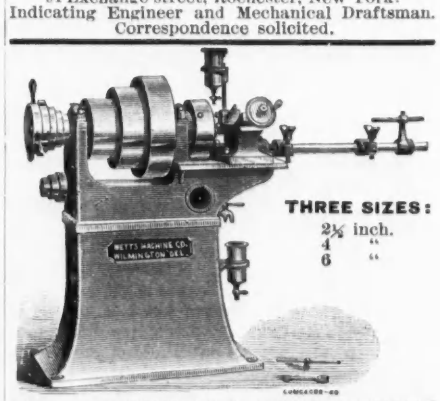
SEND FOR CATALOGUE.

THE CELEBRATED HEALD & SISCO CENTRIFUGAL PUMPS Vertical and Horizontal.

H. & S. CO., 22 CORTLANDT ST., NEW YORK.

In Writing, Mention this Paper,

E P. B. SOUTHWORTH, 94 Exchange street, Rochester, New York. Indicating Engineer and Mechanical Draftsman. Correspondence solicited.



2½ INCH CUTTING-OFF MACHINE MADE BY BETTS MACHINE CO., WILMINGTON, DEL.

NICHOLSON FILE COMPANY, *Sole Mfrs. of*

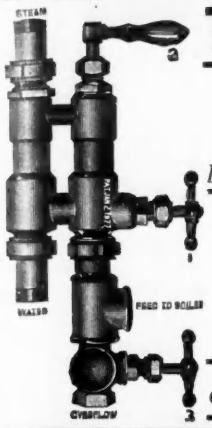
FILES and RASPS Having the Increment Cut, also, FILERS' TOOLS and SPECIALTIES.

The above illustration represents a device in which files may be held for service in surface filing, and while in this condition READILY SPRUNG, in order to give at the will of the operator, more or less convexity to the working face of the file. It does away with unusual care to obtain a true convexity or "belly" to file sides, and in fact renders great service by enabling the operator to utilize the file to its full capacity.

SURFACE FILE HOLDER No. 4, Adapted to Hold Files 12, 13 14 in. Long.
" " " " 5, " " " 14, 15, 16 "

MANUFACTORY AND OFFICE - - PROVIDENCE, R. I., U. S. A.

THE HANCOCK INSPIRATOR.



THE STANDARD

BOILER FEEDER FOR ALL CLASSES OF BOILERS.

OVER 85,000 IN USE.

Send for Circulars and Price Lists.

THE HANCOCK INSPIRATOR CO.

OFFICE, 33 INDIA WHARF, BOSTON, MASS.

THE NEW "GRESHAM" PATENT AUTOMATIC RE-STARTING INJECTOR

"Invaluable for use in Traction, Farm, Portable Marine and Stationary Boilers of all kinds. No handles required. Water supply very difficult to break. Capability of re-starting automatically, immediately after interruption to feed from any cause."

SEND FOR CATALOGUE. **RELIABLE AND CHEAP.**

Sole Manufacturers in the United States and Canada.

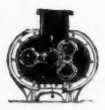
NATHAN MANUFACTURING CO.

92 & 94 LIBERTY ST., - - - NEW YORK.

ROOTS' Force Blast Rotary Blower

FOR

FOUNDRIES, SMITH SHOPS, PNEUMATIC TUBES, VENTILATION, ETC.



SLOW SPEED,
POSITIVE BLAST,
PERFECTLY BALANCED,

Best Mechanical Construction.

P. H. & F. M. ROOTS, Manufacturers,
CONNERSVILLE, IND.

S. S. TOWNSEND, Gen. Agt. } 22 Cortlandt St.
COOKE & CO., Selling Agts. } NEW YORK.

In Writing, Please Mention This Paper.

The Pump Catechism, &c.

THE PUMP CATECHISM. A practical help to Runners, Owners and Makers of Pumps of any kind. Covering the Theory and Practice of Designing, Constructing, Erecting, Connecting and Adjusting. By Robert Grimshaw, M. E. Profusely illustrated. 18mo, cloth.....$1 00

STEAM ENGINE CATECHISM. A Series of thoroughly practical questions and answers arranged so as to give to a young Engineer just the information required to fit him for properly running an engine. Fourth edition, enlarged. 18mo, cloth.....$1 00

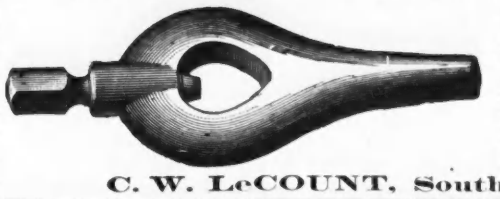
STEAM ENGINE CATECHISM. Part II. Containing answers to further practical questions received since the issue of the first volume. 18mo. cloth.....$1 00.

JOHN WILEY & SONS,

15 Astor Place, New York.

Mailed and prepaid on the receipt of the price.

REDUCED PRICES OF LECOUNT'S STRAIGHT TAIL DOG.



To be driven from a Stud in the Face Plate.

No.	INCH.	PRICE.	No.	INCH.	PRICE
1	¾	$0.60	10	2¼	$1.35
2	⅞	.70	11	2½	1.45
3	1	.70	12	3	1.60
4	1⅛	.80	13	3½	1.80
5	1¼	.80	14	4	2.10
6	1⅜	.95	15	4½	2.75
7	1½	.95	16	5	3.25
8	1¾	1.10	17	5½	4.00
9	2	1.20	18	6	5.00
1 Set to 2 in.		7.80	Full Set		31.10

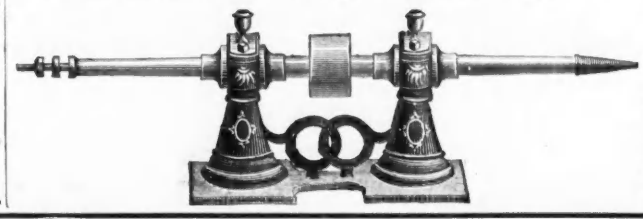
C. W. LeCOUNT, South Norwalk, Conn.

Buffing Lathes AND Buffing Materials OF All Kinds FOR Polishing Brass, Nickel, Copper, Gold, Silver, &c.

UNION STONE COMPANY,

Nos. 38 & 40 Hawley Street,

BOSTON, MASS.



Grinding, Polishing AND Plating Supplies,

Emery, Glue, Quartz, Corundum, Felt, Walrus, Leather, &c.

H.W. JOHNS' PATENT ASBESTOS ROOFING

FIRE-PROOF.

THIS is the perfected form of portable Roofing, manufactured by us for the past twenty-seven years, and is now in use upon roofs of Factories, Foundries, Cotton Gins, Chemical Works, Railroad Bridges, Cars, Steamboat Decks, etc., in all parts of the world.

Supplied ready for use, in rolls containing 200 square feet, and weighs with Asbestos Roof Coating, about 85 pounds to 100 square feet.

Is adapted for all climates and can be readily applied by unskilled workmen. Samples and Descriptive Price List free by mail.

H. W. JOHNS MANUFACTURING CO.,

SOLE MANUFACTURERS OF

H.W. Johns' Fire and Water-Proof Asbestos Sheathing, Building Felt, Asbestos Steam Packings, Boiler Coverings, Liquid Paints, Fire-Proof Paints, etc.

VULCABESTON. Moulded Piston-Rod Packing, Rings, Gaskets, Sheet Packing, etc.

Established 1858. 87 MAIDEN LANE, NEW YORK. CHICAGO. PHILADELPHIA. LONDON.

OIL CUPS

For Engines, Shafting, &c.
Illustrated Catalogue Free.

J. E. LONERGAN & CO.

Philadelphia, Penna.

BOOKS

On Mechanical Drawing, Mechanical Engineering, Steam Engines, Boilers, Etc.

LIST No. 2.

Main and Brown.—The Indicator and Dynamometer, with their Practical Applications to the Steam Engine. Illustrated. 8vo, - - - - - $1.50

Main and Brown.—Questions on Subjects Connected with the Marine Steam Engine, and Examination Papers, with Hints for their Solution. 12mo, - - - - $1.50

Main and Brown.—The Marine Steam Engine. Illustrated. 8vo, - - - - - - - $5.00

Martin.—Screw Cutting Tables for Mechanical Engineers. 8vo, - - - - - - - - 50 cents

Molesworth.—Pocketbook of Useful Formulæ and Memoranda for Civil and Mechanical Engineers. Pocket-book form, - - - - - - - - $1.00

Nicholls.—The Theoretical and Practical Boiler Maker and Engineers' Reference Book. 16 plates. 12mo. - $2.50

Norris.—Handbook for Locomotive Engineers and Machinists. Illustrated. 12mo, - - - - - $1.50

Rose.—The complete Practical Machinist: Embracing Lathe Work, Vise Work, Drills and Drilling, Taps and Dies, Hardening and Tempering, the Making and Use of Tools, Tool Grinding, Marking Out Work, etc. By Joshua Rose. Illustrated by 356 engravings. 13th edition, thoroughly revised, and in great part rewritten. 12mo, 439 pages. - $2.50

Rose.—The Slide-Valve Practically Explained. Embracing simple and Complete Practical Demonstrations of the operation of each element in a Slide valve Movement, and illustrating the effects of Variations in their Proportions, by examples carefully selected from the most recent and successful practice. By Joshua Rose, M. E., Author of "The Pattern Maker's Assistant," etc. Illustrated by 35 engravings. - $1.00

Rose.—Mechanical Drawing Self-taught: Comprising Instructions in the Selection and Preparation of Drawing Instruments, Elementary Instruction in Practical Mechanical Drawing; together with Examples in Simple Geometry and Elementary Mechanism, including Screw Threads, Gear Wheels, Mechanical Motions, Engines and Boilers. By Joshua Rose, M. E. Illustrated by 330 engravings. 8vo. - $4.00

Rose.—Modern Steam Engines: An Elementary Treatise upon the Steam Engine, written in Plain Language, for Use in the Workshop, as well as in the Drawing Office, giving full Explanations of the Construction of Modern Steam Engines; including Diagrams, showing their Actual Operation Together with complete, but simple Explanations of the Operations of various kinds of Valves, Valve Motions and Link Motions, etc., thereby enabling the Ordinary Engineer to clearly understand the Principles involved in their Construction and Use, and to Plot out their Movements upon the Drawing Board. By Joshua Rose, M. E. Illustrated by 422 engravings. 4to, 320 pages, - - - - - $6.00

Templeton.—The Practical Examinator on Steam and the Steam Engine. With Instructive References relative thereto, arranged for the Use of Engineers, Students, and others. 12mo, - - - - - - - $1.25

Watson.—The Modern Practice of American Machinists and Engineers. 86 engravings. 12mo, - - - $2.50

Wilson.—A Treatise on Steam Boilers; their Strength, Construction and Economical Working. Ill 12mo, - $2.50

Williams.—On Heat and Steam: Embracing new views of Vaporization, Condensation and Explosion. Illustrated. 8vo, - - - - - - - - $3.50

☞ *The above or any of our Books sent by mail free of postage at the publication prices, to any address in the world.*

☞ *Our large catalogue of Practical and Scientific Books, 96 pages, 8vo, and our other catalogues (including a special one of books on Steam and the Steam Engine, Mechanics, Machinery and Dynamical Engineering) and our circulars, the whole covering every branch of Science Applied to the Arts, sent free and free of postage to any one in any part of the world who will furnish us with his address.*

HENRY CAREY BAIRD & CO.,
INDUSTRIAL PUBLISHERS, BOOKSELLERS & IMPORTERS
810 Walnut St., Philadelphia, Pa., U. S. A.

T. SHRIVER & Co's IRON FOUNDRY,

333
East 56th St.,
NEW YORK.

Contracts Solicited for Machinery Castings in regular supply.

STEEL BALLS

FOR ANTI-FRICTION BEARINGS, OF BEST CAST STEEL.

HARDENED, GROUND & BURNISHED,

3-16" to 3" Diameter.

Samples and Prices on application.

SIMONDS ROLLING-MACHINE CO.,
FITCHBURG, MASS.

FORBES & CURTIS,

BRIDGEPORT, CT.,

Manufacturers of

The Forbes Pat. Die Stocks,

Power Pipe Cutting and Threading Machines, Cutting-off Machines, Ratchet Drills, Special Machinery, etc., etc.
WRITE FOR CATALOGUE.
Mention Paper.

SHEPARD'S NEW $60 SCREW-CUTTING FOOT LATHE.

Foot and Power Lathes, Drill Presses, Scroll-saw Attachments, Chucks, Mandrels, Twist Drills, Dogs, Calipers, etc.

Lathes on trial. Lathes on payment.

Send for catalogue of Outfits for Amateurs or Artisans.

Address. H. L. SHEPARD, Agent, 134 E. Second St., Cincinnati, O.

WORTHINGTON Independent Condensers

ARE NOW IN USE ON ENGINES AGGREGATING UPWARDS OF

50,000 HORSE POWER

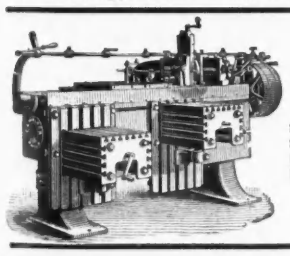
One of these machines—**the largest Independent Condenser in the world**—is applied to an engine of

8,000 HORSE POWER

SEND FOR ILLUSTRATED CATALOGUE

HENRY R. WORTHINGTON
NEW YORK
BOSTON PHILADELPHIA
CHICAGO ST. LOUIS SAN FRANCISCO

RICHARDS' PATENT COMBINATION PLANER AND SHAPER.



Only the head travels, the work remaining stationary. Several sizes, any length of bed. Combines advantages of both planer and shaper, with special advantages for many kinds of work. Durable and convenient. **SATISFACTION GUARANTEED. THERE IS MONEY IN ITS USE. TRY IT.** Send for Circular.

E. A. WALKER, Manufacturer,
75 Laurel St., Philadelphia, Pa.

BEMENT, MILES & CO.

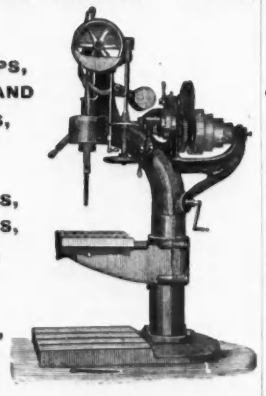
PHILADELPHIA, PA.

BUILDERS OF

METAL-WORKING MACHINE TOOLS,

FOR

RAILROAD SHOPS, LOCOMOTIVE AND CAR BUILDERS, MACHINE SHOPS, ROLLING MILLS, STEAM FORGES, SHIP YARDS, BOILER SHOPS, BRIDGE WORKS, ETC.



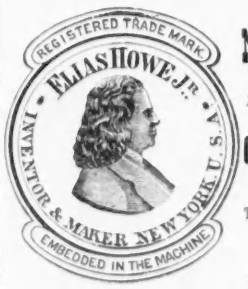
SHAPING MACHINES

For Hand and Power, 6", 8" and 10" Stroke.

Adapted to all Classes of Work to their capacity.

CIRCULARS FURNISHED.

BOYNTON & PLUMMER,
Worcester, Mass.



THE
New Howe Mfg. Co.
BRIDGEPORT, CONN.
Mfrs. of Sewing Machines
Light and Medium Weight
Gray Iron Castings
OF ALL DESCRIPTIONS TO ORDER; ALSO,
TOOL MAKING, JAPANNING
— AND —
PLATING.
Correspondence Solicited.

500 HORSE POWER OF

HARRISON SAFETY BOILERS

Are now being put in

OVER HEATING FURNACES,

By a prominent Iron Works of New England, where they have been constantly used for such purpose

DURING THE PAST EIGHTEEN YEARS.

"STEAM"

A VALUABLE BOOK for EVERY STEAM USER AND ENGINEER

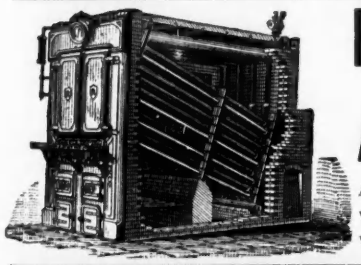
PUBLISHED FOR FREE DISTRIBUTION, BY

THE BABCOCK & WILCOX CO.

Manufacturers of

WATER-TUBE BOILERS,

107 Hope St., GLASGOW. *30 Cortlandt St., NEW YORK.*



ROOT'S NEW WATER-TUBE STEAM BOILER

SAFE! ECONOMICAL! DURABLE!

For Illustrated Catalogue of New Boiler, Address

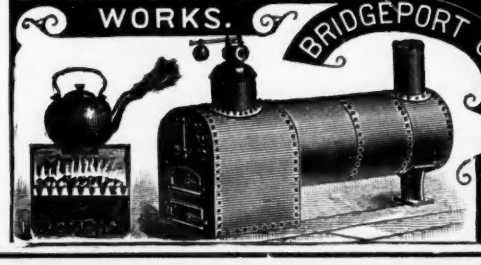
ABENDROTH & ROOT MANFG. CO.

—28 CLIFF STREET, NEW YORK.—

SELLING AGENTS,

A. B. ENSIGN, Clinton House, Rochester, New York.
A. S. FISKE, 41 Johnston Building, Cincinnati, Ohio.
WILLIAM H. SMITH, 115 Dearborn Street, Chicago, Ill.
VILLARS MERRILL, 149 N. 3d Street, Philadelphia, Pa.
WIGGS & BACON, Birmingham, Ala.
CHARLES E. ASHCROFT, 49 Mason Building, Boston, Mass.

BRIDGEPORT BOILER WORKS.

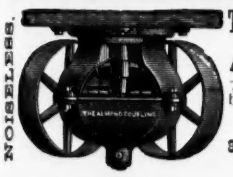


SEE THE IMPROVEMENTS IN STEAM BOILERS, BOILER FRONTS, BOILER FURNACES, AND FEED WATER HEATERS MADE AT THESE WORKS BEFORE BUYING STEAM PLANT. SEND FOR HISTORIES OF STEAM BOILERS AND FEED WATER HEATERS (FREE) ON MENTIONING THIS PAPER.

WM. LOWE.

NEWBURGH STEAM BOILER WORKS. P. DELANY.
NEWBURGH, N.Y.
MANUFACTURER OF
STEAM BOILERS OF EVERY DESCRIPTION
CARRY A LINE OF BOILERS IN STOCK FOR IMMEDIATE DELIVERY.

NOISELESS.



The Almond Coupling

A NEW quarter turn motion to replace quarter turn belts and bevel gears.

T. R. ALMOND, Mfr.,
83 & 85 Washington Street,
BROOKLYN, N. Y.

WALKER'S TOOL HOLDER.

For holding drills and reamers for lathe work. Prevents breaking or slipping. Can also be used for drilling and reaming holes by hand, and for reaming holes under drill presses, etc. Made with double handle, when required.

WALKER MFG. CO.,
CLEVELAND, OHIO.

J. WENDELL COLE, M. E.

Manager of Pennsylvania Southern Lake regions and the Northwest for

DETROIT EMERY WHEEL CO.

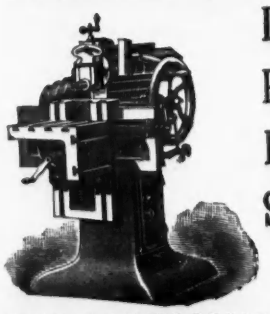
Address, Box 84, Columbus, O., or P. O. Box 152 Chicago.

Hart's Corundum-Emery Wheels.

MARCUS RUTHENBURG

STEAM. HYDRAULICS. PNEUMATICS.

64 W. 3rd ST. CINCINNATI. OHIO.



LATHES, PLANERS, DRILLS, SLOTTERS, Etc.

NEW HAVEN MANUFAC'G CO.,
New Haven, Conn.

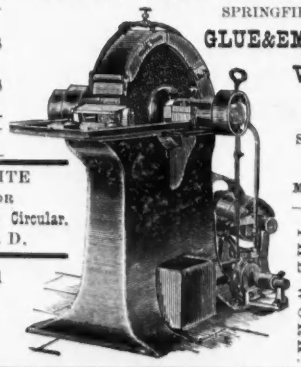
ECONOMICAL STEAM BOILERS

A SPECIALTY.

SEND FOR PRICES. **Pond Engineering Co.** ST. LOUIS, MO.

EMERY WHEEL TOOL GRINDER.

55 STYLES AND SIZES — Guaranteed Satisfactory.

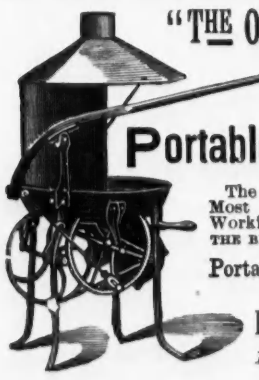


SPRINGFIELD GLUE&EMERY Wheel Co. Springfield, MASS.

WRITE FOR Illustrated Circular. No. D.

Patented Sept. 25, 1883.

Water Prevents HEATING THE WORK.



"THE ONLY PERFECT" BUFFALO Portable Forges.

The Lightest, Strongest, Most Durable, Easiest Working, and in every way THE BEST Portable Forge Made.

Buffalo Forge Co.,
BUFFALO, N. Y.

BOILER SHELL DRILLING MACHINE.

FOR MARINE WORK.

SEND FOR CUT AND DESCRIPTION.

THOS. H. DALLETT & CO.,
500 N. 13th St., PHILADELPHIA, PA.

JENKINS BROS.' VALVES

Stand at the head, are specified by architects, used in the principal public buildings, and always referred to by steam fitters when the best is called for. The Valves contain all the late improvements—using the **genuine Jenkins Disc.** Don't be deceived into buying a cheap and inferior valve, using a worthless disc, but insist on having **Jenkins Bros. Valves,** containing a **Jenkins Disc** and the only disc that will stand **high pressure** of steam. By so doing you avoid paying for the experiments of others—and get the **best.**

JENKINS BROS., 71 John Street, N. Y.; 105 Milk Street, Boston; 13 So. Fourth Street, Philadelphia,

---

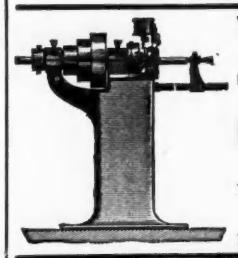
Oneida Steam Engine & Foundry Co., Oneida, N.Y.

Manufacturers of all kinds of **LATHE AND DRILL CHUCKS**

SEND FOR CATALOGUE.

CAPACITY OF	
Drill Chucks	0 to 2 in.
Lathe "	0 to 43 in.

WESTCOTT'S PATENT.

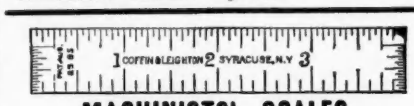


William Barker & Co.

Manufacturers of IRON AND BRASS —WORKING— **MACHINERY**

140 & 142 E. Sixth Street, N'r Culvert, Cincinnati, O.

Send for circulars and prices.



MACHINISTS' SCALES,
Patent End Graduation.

We invite comparison for accuracy with all others.

Every Scale Guaranteed. Send for List.

COFFIN & LEIGHTON, SYRACUSE, N. Y

A Complete Cutting-off Machine, **$4.00**
Larger ones which cut to 2 in. **$8.00**
SENT ON TRIAL.

Drill Presses, Tap Drill Gauges.

STERLING ELLIOTT, Newton, Mass.

"CUSHMAN" CHUCKS

Are guaranteed to be right in all respects. Ask to see them at your dealers, or write direct to the factory. Respectfully,

THE CUSHMAN CHUCK CO.,
HARTFORD. CONN.

UNIVERSAL RADIAL AND RADIAL DRILLING MACHINES

THREE DESIGNS: SIX SIZES
EMBODY ALL DESIRABLE FEATURES
PRICES $450.00 & UPWARD
ADDRESS UNIVERSAL RADIAL DRILL CO
CINCINNATI O U.S.A

HOOPER'S 70% GRATE BAR.

Will not Warp.
Will not burn off at the ends.
Will give absolutely 70% air space.
Will give uniform combustion of fuel.

Send for Circular and Price List to

ALEXANDER TRAUD,
EAST FERRY STREET IRON WORKS,
NEWARK, N. J.

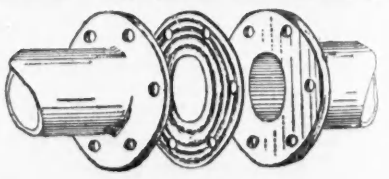
Joints made absolutely tight and durable by pat. corrugated

COPPER GASKETS

Furnished in all shapes and sizes for flanged PIPES, CYLINDERS, CHESTS, Etc.

Price List and Sample Free.

U.S. MINERAL WOOL CO., 22 Cortland St., N.Y.



Established in 1874.

CLEVELAND TWIST DRILL CO.

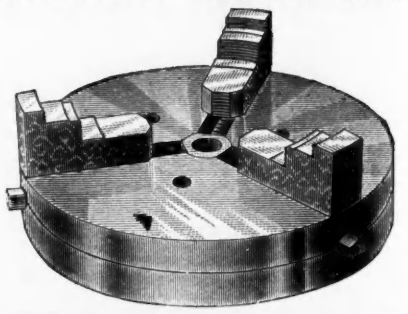
24 and 26 West Street, Cleveland, O.
101 Chambers Street, New York.
85 Queen Victoria St., London, Eng.

Christiana Machine Co., Christiana, Pa.,

Manufacture Shafting, Pulleys, Hangers, Gearing, Steam Engines and Turbine Water Wheels. Special attention to furnishing Castings to the trade. Philadelphia office, 206 N. Fourth street.

ESTABLISHED 1851.

The Horton Lathe Chuck.



THE E. HORTON & SON CO.

Canal St., Windsor Locks, Conn., U. S. A.

LINK-BELTING

AND

SPROCKET WHEELS,

LINK-BELT MACHINERY CO.

CHICAGO.

NEW YORK. MINNEAPOLIS.

Burr & Dodge, 125 N. 5th St., Phila.

DISCOUNT TO CLUBS. WRITE FOR FULL LIST.

HARDENED

STEEL SQUARES

and other

Fine Tools,

Manufactured by

STANDARD TOOL CO.

ATHOL, MASS.

STANDARD PUNCHES FOR IRON & STEEL PLATES.

DROP FORGINGS

(IRON AND STEEL)

MADE TO ORDER AT LOW PRICES.

BRADLEY & PIERSON MFG. CO.,

Foot of CLAY STREET, NEWARK, N. J.

IRON LEVELS,

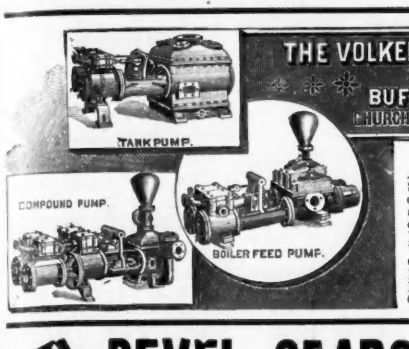
Manufactured by

C. F. RICHARDSON, Athol, Mass.

Morse Twist Drill and Machine Company, New Bedford, Mass.

Manufacturers of **Morse Patent Straight-Lip Increase Twist Drills.**

SOLID AND SHELL REAMERS, BEACH'S PATENT SELF-CENTERING CHUCK, BIT STOCK DRILLS.
DRILL GRINDING MACHINES, MILLING CUTTERS AND SPECIAL TOOLS TO ORDER.



THE VOLKER & FELTHOUSEN M'F'G. CO.

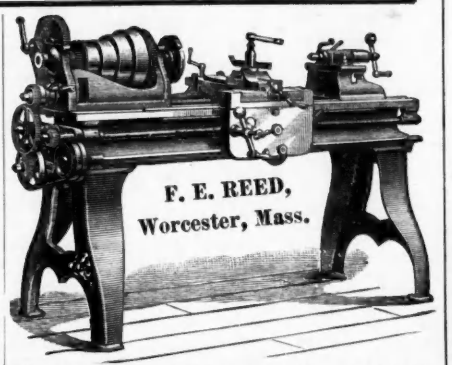
MANUFACTURERS OF
BUFFALO DUPLEX STEAM PUMPS.
CHURCH, BIRD & ALL S. MECHANIC STS. BUFFALO N.Y.

FOR SALE AT FACTORY PRICES BY

A. Aller, New York; S. C. Nightingale & Childs, Boston; Henry I. Snell, Philadelphia; Thos. J. Bell & Co., Cincinnati; Shaw, Kendall & Co., Toledo; Geo. Worthington & Co., Cleveland; N. O. Nelson Mfg. Co., St. Louis & Kansas City, Mo; Goulds & Austin, Chicago; C. E. Kennedy, Denver, Col.; Sheriff & Ashworth, Pittsburgh, Pa.; Jos. Baur, Manistee, Mich.; Jas. Jenks & Co., Detroit, Mich.; Wickes Bros., East Saginaw; Adolf Leitelt, Grand Rapids; E. F. Osborne, St. Paul, Minn.; Kruse & Barker, Milwaukee Wis.; Joshua Hendy Machine Works, San Francisco; Flynn & Emrich, Baltimore, Md.; Forbes, Liddell & Co., Montgomery, Ala.; Bailey & Lebby, Charleston, S. C.; O. B. Goodwin, Norfolk, Va.

BEVEL GEARS,

Cut Theoretically Correct.
For particulars and estimates apply to
BREHMER BROS.
Machinists,
440 N. 12th St., Philadelphia, Pa.



ENGINE Lathes, Hand Lathes, Foot Lathes, Upright Drills and Milling Machines. Agents, MANNING, MAXWELL & MOORE, 111 LIBERTY STREET, NEW YORK.

MACHINERY

For Reducing and Pointing Wire.

Especially Adapted to pointing wire rods and wire for drawing.

For Machines or information, address the manufacturer.

S. W. GOODYEAR, Waterbury, Ct.

Section of **Copper-Wire-Sewed Light Double Belting,** specially adapted to use on cone pulleys and other hard places. Manufactured by the **PAGE BELTING CO., Concord, N. H.** Also manufacturers of Staple and Special Grades of Leather Belting and the "Hercules" Lacing. Send for Catalogue No. 2.

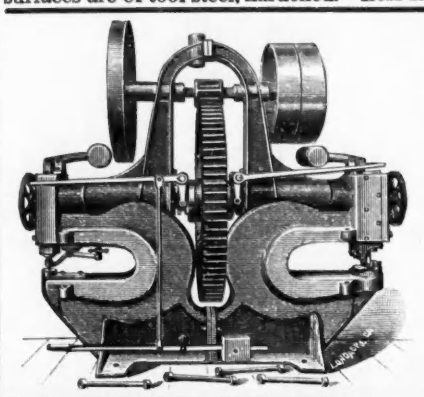
D. SAUNDERS' SONS, Yonkers, N.Y.

MANUFACTURERS OF

Pipe Cutting, THREADING, AND Tapping Machines.

Steam and Gas Fitters' Hand Tools.
SEND FOR CIRCULAR.

THE PATENT WHEEL PIPE CUTTER shown in the cut combines simplicity with strength and lightness. Easily adapted to various sizes of pipe. Rolling instead of sliding motion. No loose parts to become detached and mislaid. All wearing surfaces are of tool steel, hardened. Less friction of parts than any other pipe-cutter made.



HILLES & JONES,

WILMINGTON, DEL.

PUNCHES & SHEARS

Improved
A FULL LINE OF **Horizontal Punches.**

BOILER-SHOP TOOLS.

✣ FOSSIL MEAL ✣

PIPE AND BOILER COVERING.

Light as Hair Felt. Absolutely Fireproof. Easily applied. Can be used over and over again. Thickness of 5/8" to 3/4"; equal to other coverings at 2' to 2½".

Beware of Imitations. Sold in Bags of 110 lbs. each.

Acknowledged by leading authorities to be the best non-conducting material in the market.

FOSSIL MEAL CO., 48 Cedar St., New York.

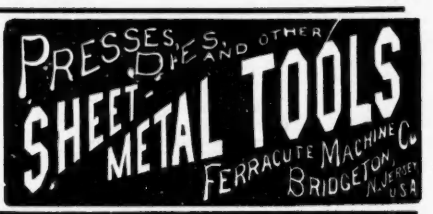
Send for Circular. Mention this Paper.

American Twist Drill Company's

PATENT CHUCK JAWS.

Three sizes. Price per set of 4 Jaws, $40, $48, $56. Bolted to lathe face plates, they make best and cheapest chuck in the world. Address orders, Laconia, N. H.

HILL, CLARKE & CO., Boston and St. Louis.
MANNING, MAXWELL & MOORE, N. Y. City.
TALLMAN & McFADDEN, Philadelphia, Pa.
or WM. BINGHAM & CO., Cleveland, Ohio.



MASON : REDUCING : VALVE

IS GUARANTEED NOISELESS, AND SENT ON THIRTY DAYS' TRIAL. SEND FOR CIRCULARS TO
MASON REGULATOR CO., 22 CENTRAL ST., BOSTON, MASS.

Grinds Drills ¼ to 1 5/16 in. inclusive.

THE HOUGH TWIST DRILL GRINDER

The SPECIAL CLAIMS made for this Tool are its

Simplicity, Ease of Operation, Low Price.

—MANUFACTURED BY—

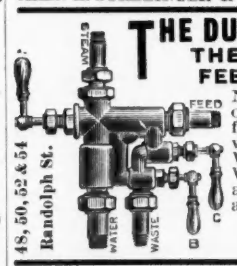
Warner & Hough Machine Co.
ST. PAUL, MINN.

Manning, Maxwell & Moore, 111 Liberty St., New York. | Tallman & McFadden, 1025 Market St., Phila.

—OUR— NEW **Catalogue of Tools**

and Supplies sent free to any address on receipt of Ten Cents in Stamps (for postage).

CHAS. A. STRELINGER & CO., Wood Ave., Detroit, Mich.



THE DUPLEX INJECTOR

THE BEST BOILER FEEDER KNOWN.

Not liable to get out of order. Will lift water 25 feet. Always delivers water *hot* to the boiler. Will start when it is hot. Will feed water through a heater. Manufactured and for sale by.

JAMES JENKS & CO.
Detroit, Mich.

IS A NATURAL PRODUCT TAKEN FROM OUR OWN MINES.

Unlike any of the artificial compounds or manufactured products heretofore on the market. We

FLUOR SPAR

Send for Circular, Prices

THE BEST

and Experience of Users.

FOUNDRY FLUX

guarantee its success, if directions are followed, or *ask no pay.*

Only 8 or 16 lbs. to the ton of iron required to purify the iron, and will more than pay for itself in keeping the cupola clean.

THE EVANSVILLE LEAD & SPAR MINING CO., Successors to B. Burbank & Co., Evansville, Ind.

FRICTION CLUTCH PULLEYS AND CUT-OFF COUPLINGS.

JAS. HUNTER & SON,
North Adams, Mass.

Iron and Steel
DROP FORGING

Of Every Description, at Reasonable Prices.
THE R. A. BELDEN CO., DANBURY, CT.

DIXON'S Graphite Paint

FOR BOILER FRONTS.

Two coats will last two years. Send for circular.

Joseph Dixon Crucible Co.
JERSEY CITY, N. J.

L. W. Pond Machine Co.
Manufacturers of and Dealers in
IRON WORKING MACHINERY.

Iron Planers A Specialty.

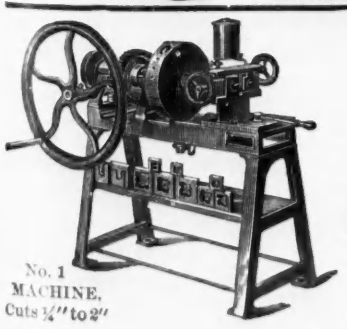
140 Union St.
Worcester, Mass.

PECK'S PAT. DROP PRESS.

NEW HAVEN
BEECHER & PECK. CONN.

DROP FORGINGS OF IRON OR STEEL

BEECHER & PECK, NEW HAVEN CONN.



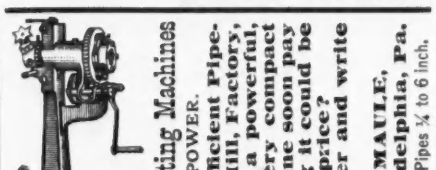
THE EATON, COLE & BURNHAM CO.

82 & 84 Fulton Street, New York,
MANUFACTURERS OF
PIPE CUTTING and THREADING MACHINES
OPERATED BY HAND OR POWER.

FITTINGS, VALVES, PIPE, PIPE TOOLS,

AND ALL STYLES OF IRON AND BRASS GOODS FOR
STEAM, WATER AND GAS.
Factory, Bridgeport, Conn.

No. 1 MACHINE, Cuts ¼" to 2"



PRINT Your Own CARDS

PRESS, $3. Circular size, $8. Newspaper size, $44. Type-setting easy; printed directions. Send 2 stamps for Catalogue of Presses, Type, Cards, etc., to Factory. KELSEY & CO., Meriden, Conn.

"ECLIPSE" Pipe-Cutting Machines
FOR HAND OR POWER.

Don't you have sufficient Pipe-Work about your Mill, Factory, or Shops to make a powerful, convenient and very compact Pipe-Cutting Machine soon pay for itself, providing it could be had at a moderate price? Mention this paper and write us for particulars.

PANCOAST & MAULE,
Philadelphia, Pa.

Made in Three Sizes, Cutting Pipes ¼ to 6 inch.

BOILER FEED PUMP

MADE BY
M. R. MUCKLE, Jr. & CO.
PHILADELPHIA.

SIZES TO SUIT STEAM PLANTS, UP TO 300 H. P.

Send For CirculaR.

S. Ashton Hand Mfg. Co., Toughkenamon, Pa.

Hand's Twist Drill Grinding Attachment.

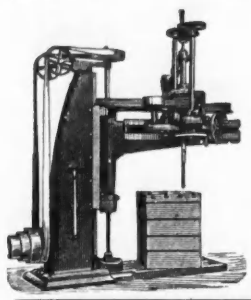
Readily attached to any grindstone, emery or cutter-grinder. Grinds right and left hand drills from 3/8" diam. down to smallest sizes

PRICE, $20.

WELDLESS STEEL — QUICK OPENING GATE VALVE — COLD DRAWN TUBES

SMOOTH INSIDE & OUT.

JOHN S. LENG, 4 Fletcher St. N.Y.



WILLIAM SELLERS & CO. INCORPORATED.

Engineers and Manufacturers of

IMPROVED MACHINE TOOLS FOR WORKING IRON AND STEEL

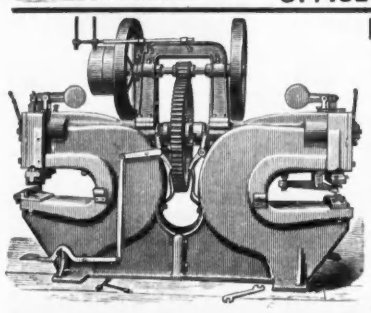
STEAM HAMMERS, PUNCHES and SHEARS, LATHES, PLANERS, BENDING ROLLS, BORING and TURNING MILLS, DRILL and TOOL GRINDERS, Etc., Etc.

SHAFTING, PULLEYS, HANGERS, COUPLINGS, Etc.

Improved Injectors for Feeding Boilers.

PAMPHLETS, PHOTOTYPES AND PRICES FURNISHED ON APPLICATION TO

OFFICE AND WORKS, PHILADELPHIA, PENN.



THE LONG & ALLSTATTER CO. Hamilton, OHIO.

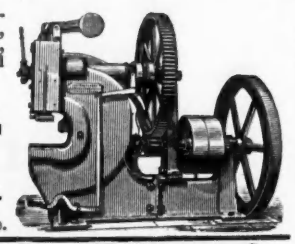
Double, Single, Angle-Bar, Gang, Horizontal, Twin, Boiler, Spacing, Gate, Multiple, Belt and Steam-Driven

Punches and Shears.

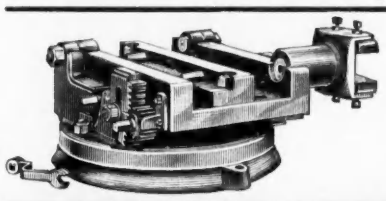
Over 300 Sizes.

ALSO,

Power Cushioned Hammer.



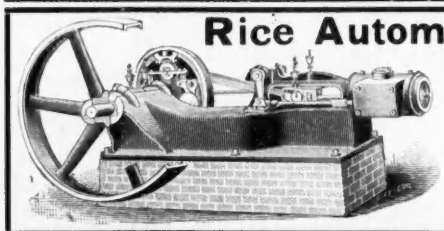
Send for new Catalogue.



Greenwood's Universal Planer Chuck.

For Straight, Curved (Concave or Convex), or Angle Work. Used on any Planer with Cross-Feed for Links, Wedges, Keys, etc. Indispensable for Locomotive Builders and Master Mechanics. Circulars with full description on application.

PEDRICK & AYER, - Philadelphia, Pa.



Rice Automatic Cut-off Engine

Self-Contained. Sensitive Governor.
Balanced Valve. High Speeds.
Stationary Oilers. Best Economy.

Gold Medal Cincinnati Exposition, 1884.

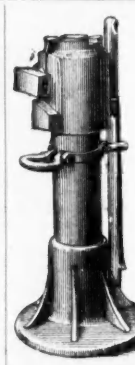
THE JOHN T. NOYE MFG. CO.,
BUFFALO, N. Y.

THE

Slate Sensitive Drill

Adapted to rapid work with small drills. Its extreme sensitiveness prevents clogging and breakage of drills. Has a switching table with attachment for center drilling. Instantly adjustable to different lengths of work. Over 200 already in use. Send for circular.

DWIGHT SLATE,
HARTFORD, - - CONN.



Hydrostatic Machinery

PRESSES, PUMPS, PUNCHES,

ACCUMULATORS

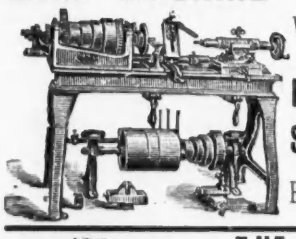
JACKS, VALVES, FITTINGS,

Vault Elevators, Etc.

WATSON & STILLMAN,
204-210 E. 43d St., New York.

VOLNEY W. MASON & CO.,
Friction Pulleys, Clutches and Elevators,
PROVIDENCE, R. I.

GAGE MACHINE WORKS,



Waterford, N. Y

Manuf'r's of

Fox, Turret AND Speed Lathes AND Brass Finishers' TOOLS.

THE NATIONAL FEED-WATER HEATER.

A brass coil heater supplying feed water at 210° to 212° Fahrenheit by use of exhaust steam.

Our prices are low and reasonable, and we aim to supply the *cheapest, best and most effective Heater in the market.* Sixteen sizes. 10 H.P., $20; 100 H.P., $150; 500 H.P., $600. Iron, Brass and Copper Coils and Bends made to order. Circulars and price lists sent on application.

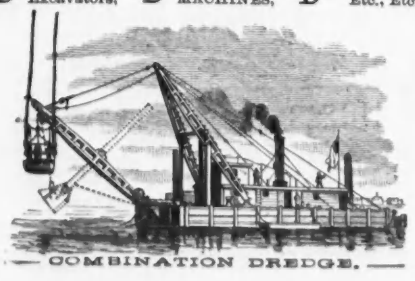
National Pipe Bending Co.
NEW HAVEN, CONN.

OSGOOD DREDGE CO., - ALBANY, N. Y.

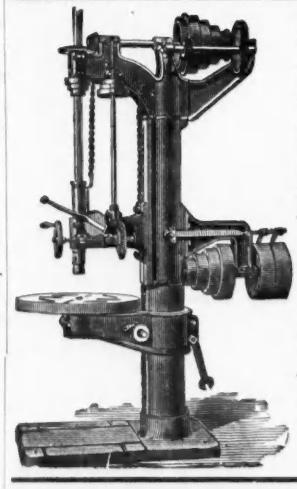
RALPH R. OSGOOD, Pres. JAMES H BLESSING, Vice-Pres.
JOHN K. HOWE, Secretary and Treasurer.

Manufacturers of

DREDGES, Excavators, DITCHING MACHINES, DERRICKS, Etc., Etc.



— COMBINATION DREDGE. —



UPRIGHT DRILLS

A SPECIALTY,

ALL SIZES WITH PATENT QUICK RETURN FEED AND ALL MODERN IMPROVEMENTS,

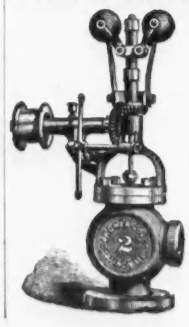
H. BICKFORD, Cincinnati, Ohio.

WOOD-WORKING MACHINERY

For Planing Mills, Furniture, Chair and Cabinet Factories, Cabinet Works and General Wood-Working. Send Stamp for Illustrated Catalogue to

Rollstone Machine Co.
45 WATER ST.,
FITCHBURG, MASS.

THE GARDNER GOVERNOR



Over 45,000 in Use.

ADAPTED TO EVERY STYLE OF STATIONARY AND PORTABLE STEAM ENGINE.

Warranted to give satisfaction or no sale.

FOR CIRCULARS AND PRICES, ADDRESS

The Gardner Governor Co.
QUINCY, ILL.

SOUTHWARK FOUNDRY & MACHINE CO.

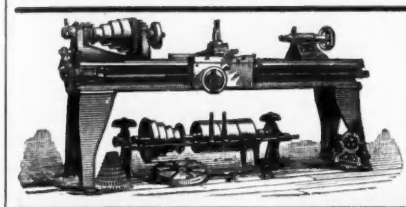
PHILADELPHIA, PA.

General Machinists, Founders and Boiler Makers.

Heavy Machinery of all Kinds a Specialty.

HALL DUPLEX STEAM PUMPS

HALL STEAM PUMP CO.,
No. 91 Liberty Street, - - - - New York.



16 in. and 18 in. ENGINE LATHES.

New Designs. Low Prices.

THE MULLER MACHINE TOOL CO.
182 W. Pearl St., CINCINNATI, O.

ACME MACHINERY CO.,

CLEVELAND, OHIO.

Manufacturers of

"ACME"

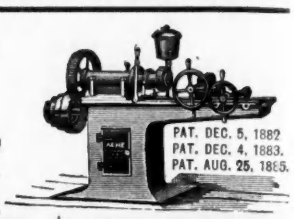
Single & Double Automatic Boltcutters,

cutting from 3-8 in. to 6 in. diameter,

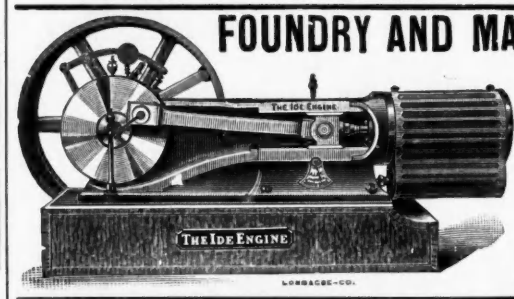
Also SEPARATE HEADS AND DIES.

Send for Catalogue and Discounts.

Agents, Manning, Maxwell & Moore, New York.



FOUNDRY AND MACHINE DEPARTMENT,



HARRISBURG CAR MFG. CO.

HARRISBURG, PA.

Highest Award Silver Medal AND Diploma

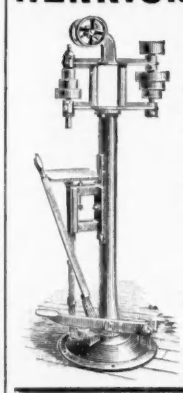
AT FRANKLIN INSTITUTE NOVELTY EXHIBITION, PHILADELPHIA.

We are operating the finest and most successful Electric Light Stations in the world. A change of speed not exceeding one per cent guaranteed, running light and loaded. Send for catalogue.

CRANK PLANERS

Superior Design & Workmanship, Extra Heavy (1500 lbs.)
DOWN, ANGULAR AND CROSS-FEED,
TO PLANE 12x16x15.
THE R. A. BELDEN CO., DANBURY, CT.

HERRICK & COWELL,



Manufacturers

Drill Presses,

POWER AND FOOT

PRESSES,

Hand Lathes,

Paper Box and Special Machinery.

37 Artisan St.,
New Haven,
Conn.

Send for Catalogue.

Our Patent Rotating Fans are invaluable for Restaurants, Hotels, Meat Markets, Saloons, Lunch Counters, Groceries, Bakeries, Confectioneries, and in fact all places troubled with *heat* or *flies*. The only perfect Fan made that can be driven at any speed without disturbing the belt.

WE ALSO MANUFACTURE THE CELEBRATED BACKUS WATER MOTOR

Prices, from $6 to $35. Send for circular, to

BACKUS WATER MOTOR CO., NEWARK, N. J

MACHINERY.

BARGAIN LIST.

Two	16″	swing,	6′	bed,	Engine Lathes (Porter),	new.
One	17″	"	8′	"	" (Wright),	"
"	20″	"	8′	"	"	"
"	24″	"	12′	"	"	"
"	22″x 22″x 5′				Pond Planer,	second hand.
"	40	H. P.			Stationary Engine 12″x20″ Cyl.,	new.
"	30	"			" 10″x20″ "	"
"	35	"			" 11″x16″ "	"
"	25	"			" 10′ x12″ "	"
"	20	"			" 9″x22″ "	2d. hd.
Four	8	"			" 6″x12′ "	"
Two	9	"			" 6½″x12″ "	"
One	15	"	Upright		" 8″x9′ "	"
"	10	"	"		" 7″x16″ "	"
"	20	"	Coil Boiler (Waterhouse),			second hand
"	8	"	Portable Engine 6″x12″ cyl.			"

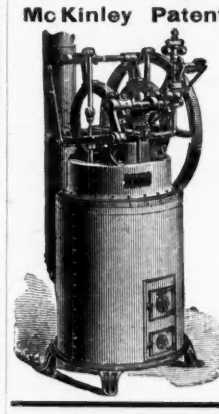
Also large stock of new and second hand Engines, Boilers and Machinery, not mentioned above. Correspondence solicited.

S. L. HOLT & CO.,
67 SUDBURY STREET, BOSTON, MASS.

McKinley Patent

Air Engine.

The Best and Cheapest on the Market.



No Steam. No Water. Absolute Safety. No Engineer. No pumps. No Gauges. No liability to freeze up. No Regulation required.

NO EXTRA INSURANCE.

Can be used for any purpose where power is required.

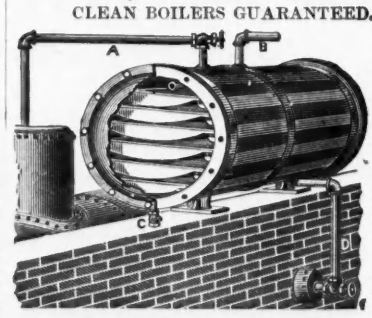
Cheap Fuel. Cheap First Cost.

McKinley Engine Co.
17 Broadway,
CINCINNATI, O.

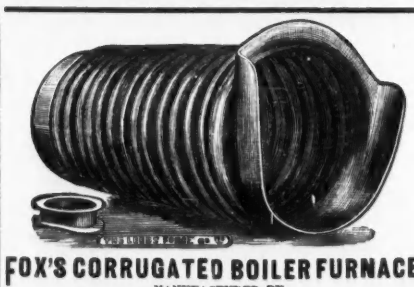
THE NEW HOPPES LIVE STEAM FEED-WATER

Heater and Lime Extractor.

CLEAN BOILERS GUARANTEED.



THE HOPPES MFG. CO.
SPRINGFIELD, O.
—Send for Catalogue D.—



FOX'S CORRUGATED BOILER FURNACES

MANUFACTURED BY

THE LEEDS FORGE CO., Limited, of England.

SAMSON FOX, C. E., Manager.

Best Yorkshire Steel (Siemens') Boiler Plates.

J. BEAVOR-WEBB, 76 Wall St., New York.

AMERICAN AND CANADIAN AGENT.

SECOND-HAND TOOLS FOR SALE

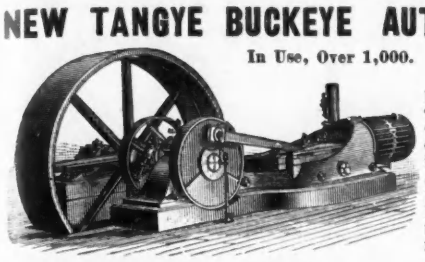
BY

POOLE & HUNT, Baltimore, Md.

1 Planing Machine. Will plane 35 in. wide, 27 in. high, and 16 ft. in. long.
1 Planing Machine. Will plane 30 in. wide, 26 in. high, and 5 ft. 6 in. long.
1 Planing Machine. Will plane 24 in. wide, 22 in. high, and 5 ft. long.
1 Double Geared Chasing Lathe. Will swing 24 in. dia., 8 ft. 6 in. long.
1 Drill Grinding Machine. Made by Wm. Sellers & Co.

NEW TANGYE BUCKEYE AUTOMATIC CUT-OFF ENGINES.

In Use, Over 1,000. 25 to 1,000 H. P.

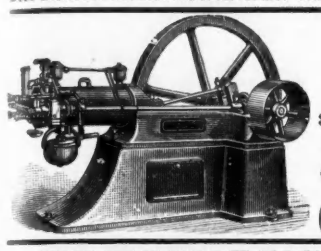


These Engines are the combined result of long experience with automatic cut-off regulation, and most careful revision of all details They are designed and constructed for heavy and continuous duty at medium or high rotative speeds. Highest attainable Economy in Steam Consumption and superior regulation guaranteed. Self-contained Automatic Cut-off Engines 12 to 100 H. P. for driving Dynamo Machines *a specialty*. Illustrated Circulars, with various data as to practical Steam Engine construction and performance, free by mail. **Address, BUCKEYE ENGINE CO., Salem, Ohio.**

SALES AGENTS: W. L. SIMPSON, 70 Astor House, N. Y. | N. W. ROBINSON, cor. Clinton & Jackson Sts., Chicago, Ill. | ROBINSON & CARY, St. Paul, Minn.

KENSINGTON ENGINE WORKS, LIMITED, PHILADELPHIA,

Sole Licensees and Manufacturers for New Jersey (South of Trenton), Eastern Pennsylvania, Delaware, Maryland and Virginia.



"OTTO" GAS ENGINE WORKS.

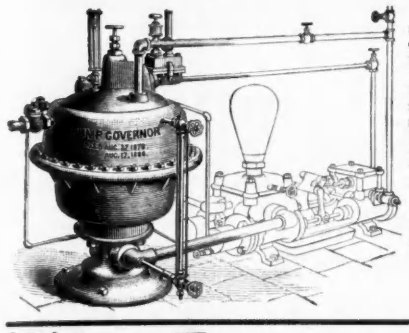
SCHLEICHER, SCHUMM & CO.,

33d and Walnut Sts. PHILADELPHIA. Branch Office, 130 Washington St. CHICAGO.

OVER 20,000 ENGINES IN USE.

GUARANTEED To Consume 25 to 75 Per Cent. Less Gas than ANY Other Gas Engine doing the same work.

BLESSING'S PUMP GOVERNOR.

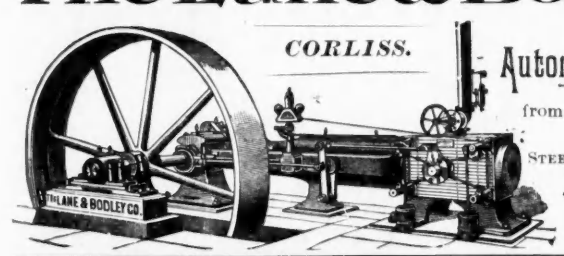


For use in returning the water of condensation to steam boilers under circumstances which make the employment of the steam trap undesirable, as where the pressure in heating systems is greatly reduced below boiler pressure, or where sufficient head room is lacking. Is used in connection with a steam pump, so controlling the action of the pump that its piston speed is at all times exactly proportionate to the varying quantity of water to be returned. No stuffing boxes are used in its construction, and friction is reduced to a minimum. Can be adapted to suit a wide range of conditions.

Send for circular of **Blessing's Albany Steam Trap, Blessing's Water Circulator and Purifier, and Blessing's Renewable-Seat Stop and Check Valves.**

ALBANY STEAM TRAP CO., Albany, N. Y.

The Lane & Bodley Co.



MANUFACTURERS OF

Automatic Cut Off Engines,

from heavy patterns and of unexcelled workmanship.

STEEL BOILERS, FEED WATER HEATERS, SHAFTING, PULLEYS & GEARING.

THE LANE & BODLEY CO.
East side John, cor. Water, Cincinnati, O.

PORTER-HAMILTON ENGINE.

FOR HEAVY WORK AND LARGE POWERS.
EXTRA HEAVY DESIGN.
Send for Catalogue.

WILLIAM TOD & CO.,
YOUNGSTOWN, OHIO.

THE SKINNER ENGINE CO.

ERIE, PA.

PORTABLE AND STATIONARY
ENGINES and BOILERS
Send for Catalogue and Prices.

MACHINERY,

NEW AND SECOND-HAND.

12 in. S., 5 ft. Bed Engine Lathe, New
13 in. x 6 ft. Bed Engine Lathe, Ames, new.
14 " 7 ft. Bed Engine Lathe, Bogert new
15 " 6 ft. " " " Pratt & Whitney.
17 " 6 ft. " " " Putnam, not screw cutting.
17 " 6', 7' " " Hewes & Phillips.
19 " 12,14" " " Pond, nearly new.
20 in. x 6 ft. Engine Lathe Putnam, good order.
20 in. x 10 ft. Engine Lathe, Harris, cheap.
24 " 12-14 and 20 ft. Ames, new.
29 " 12 ft. " " " Harrisburg.
30 in. x 12 ft, Engine Lathe, New Haven.
34 " 12 ft. " " Harrisburg, good.
42 in. x 16 ft. Engine Lathe, Ames, New.
52 in. Gap Bed Extension Engine Lathe.
16x6 ft. Turret Fox Lathe with chasing bar, new.
14 in.-20 in. and 33 in. Turret Head Chucking or Screw Machines, Bridgeport.
20-23 in., 25 in. and 28 in. Drills, Blaisdell, new.
20 in. Drill, Prentice.
20 " " Davis.
No. 1 and 2 Slate's Sensitive Drill.
Elliott Drill. Slate's Gang Drill.

SHAPERS.

15 & 24 in. Wolcott. 12 in Sellers.
20 in. Bridgeport 10-15-20-25-30 in. Stroke G. & E.

PLANERS.

16x42 in. Bridgeport. 24 in. x 6 ft. Hendey, New.
24 in x 6 ft., Powell. 24 in. x 8 ft. Ames.
26 in. x 6&8 ft., " 22 in. x 4 ft., 5 ft. and 6 ft. Powell.
30 in. x 7 ft. Planer, New Haven.
30 in. x 10 ft. Hendey, New.
36 in. Squaring Shear, power, nearly new.
No. 3½ and 4 Press, Stiles
2,250 lb. Steam Hammer, Bement.
800 lb. Drop Hammer, Merrill.
Boiler Shop Punch, Stiles.

Lot of miscellaneous Machinery If you do not see what you want, write and state what is required. Will Remove Apr. 1st to 72 Warren St., and 62 College Pl.

E. P. BULLARD, 14 Dey St., New York.

PATENT UNIVERSAL SCREW-CUTTING, CENTER, DEPTH ANGLE AND **TWIST DRILL GAUGE.**
J. WYKE & CO.
Fine Machinists' Tools, E, BOSTON, MASS. Send for Circular.

To Buyers of Engine Lathes

We are now making from entirely new designs, *extra heavy* 19" and 21" Engine Lathes (the most popular sizes), of which we are making a specialty, and manufacturing in lots of not less than 100 at a time.

We make no charge for extras. Every lathe is furnished with *hollow spindle*, the 19" with 1⅝" hole, and 21' with 1⅞" hole. Every lathe has substantial *compound rest*, heavy tool post (bar steel), rest to turn full swing, *following rest* with adjustable jaws to take any size from 2½" down, with extra tool for shafting.

Full set of gears to cut from 2 to 18 threads including 11½ pipe thread. *Automatic stop on carriage. Separate screw and rod feed*, and the most substantial and easily managed *taper attachment* made. Cones and gears of large diameter and wide belt. Studs, screws and small gears are *steel or gun metal*. Webbed live heads, heavy tail stocks. No worm or worm gears, no weak reverse plate. *Perfect lubrication for all running parts*, including carriage.

Lead screw inside of shear, double nut (cut from solid), and taking hold of carriage directly under the line of strain. Friction counter-shaft, the most durable made. Our prices are reasonable for cash, and from which no deviation will be made. Our written guarantee accompanies every lathe.

GUARANTEE.

We guarantee this lathe to be equal in workmanship, truth, accuracy, solidity, material and finish, to the best made, and hold ourselves legally liable for this guarantee.

LODGE, DAVIS & CO.

MANUFACTURERS

Machine Tools,

159, 161, 163 and 165 EGGLESTON AVE.,
136, 138, 146, 148, 150, 152, 154 E. 6th St.

CINCINNATI, OHIO.

(See our advertisement on last page.)

The Watts, Campbell Co.,

NEWARK, N. J.

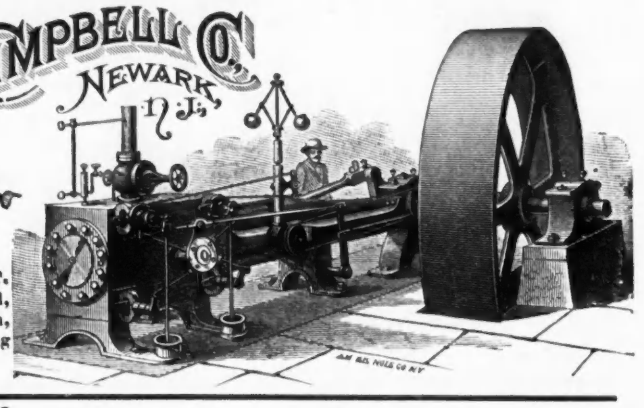
MANUFACTURERS OF IMPROVED CORLISS STEAM ENGINES IN FULL VARIETY.

Sizes Varying From

30 to 2000 Horse Power.

Horizontal or Vertical, Direct Acting or Beam, Condensing, Non-Condensing or Compound.

Send for Circular.



HEWES & PHILLIPS

Iron Works.

IMPROVED

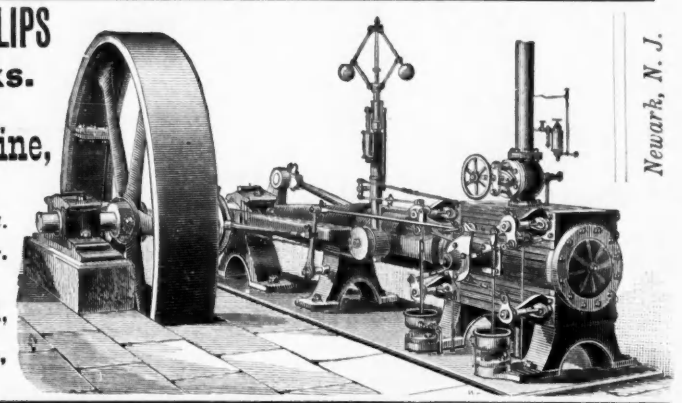
Corliss Engine,

High Pressure, —Condensing— and Compound.

Send for Circular.

AGENT

Geo. A. Barnard,
(175 Temple Court)
7 Beekman Street, NEW YORK.

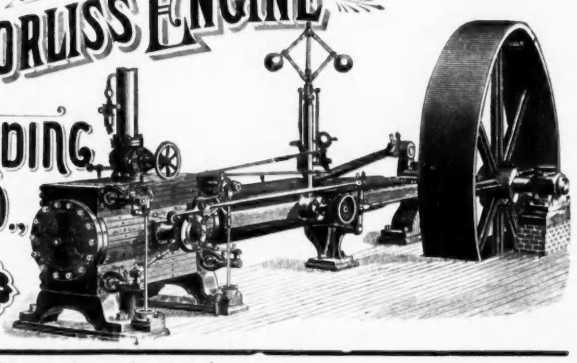


Newark, N. J.

THE IMPROVED FISHKILL CORLISS ENGINE

BUILT BY THE FISHKILL LANDING MACHINE CO.,

FISHKILL ON THE HUDSON, N.Y.



Robert Whitehill, NEWBURGH, N.Y.

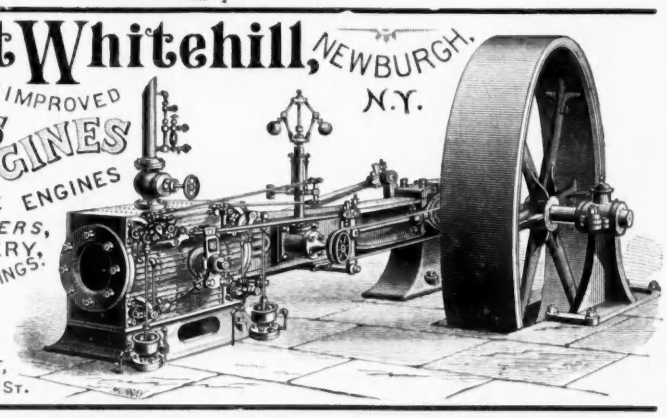
MANUFACTURER OF IMPROVED

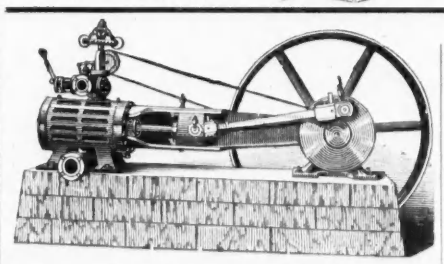
CORLISS ENGINES

ALSO SLIDE VALVE ENGINES

STATIONARY BOILERS, GENERAL MACHINERY, IRON AND BRASS CASTINGS.

NEW YORK OFFICE
Room 6,
COAL AND IRON EXCHANGE,
COR. CORTLANDT & CHURCH ST.





STEARNS MFG. COMPANY,

ERIE, PA.

Engines from 15 to 400 Horse Power.

Boilers of Steel and Iron supplied to the trade or the user. Send for Catalogues.

SAW MILLS and GENERAL MACHINERY.

Works at ERIE, PA.

EXTRA HEAVY LATHE

WE ARE MAKING A SPECIALTY OF A 24-INCH LATHE, WITH BED ANY LENGTH DESIRED. THIS LATHE IS DESIGNED FOR SEVERE SERVICE; IT IS THE HEAVIEST OF ITS SIZE EVER PRODUCED, AND THE WORKMANSHIP AS GOOD AS SKILL CAN MAKE IT.

SEND FOR CIRCULAR.

S. S. HEPWORTH & CO., "Glenwood Station," Yonkers, N. Y

JOHN McLAREN,

HOBOKEN, N. J.

BUILDER OF

CORLISS ENGINES,

AIR COMPRESSORS AND BOILERS.

HILL, CLARKE & CO.

IRON AND BRASS WORKING

MACHINERY.

LATHES, PLANERS,
BOLT CUTTERS, SHAPERS,
UPRIGHT DRILLS,
BORING MILLS,
PULLEY MACHINES,
POWER HAMMERS,
MILLING MACHINES,
PIPE MACHINES,
ETC.

MACHINE SHOP SUPPLIES.

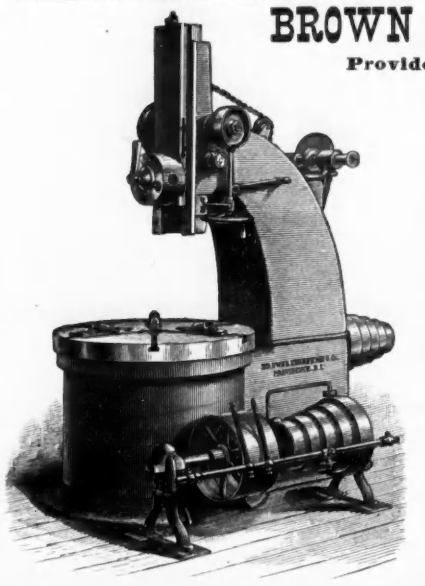
36 to 42 OLIVER ST.,

BOSTON, MASS.

BROWN & SHARPE MFG. CO.,

Providence, R. I., Manufacturers of

MACHINERY AND TOOLS.



Description of No. 2 Vertical Chucking Machine.

Patent August 4th, 1885.

With this Machine, from two to four times as much work can be accomplished in a given time as can be done upon an Engine Lathe, and in a much superior manner, the work being more easily trued and fastened in place than upon any machine having a horizontal spindle, and the different tools in the turret-head easily brought into operation in succession, while from the perpendicular position of the same, the chips fall through the center of spindle of revolving table to the floor, causing no trouble by clogging of reamers, &c.

It has the Capacity to take a pulley 36 in. diam., 18 in. face, and hub of 12 in. in length, and to bore a 4-in. hole in same, making two or three cuts, and finish by reaming, without removing the tools or work.

The Revolving Table is driven by a 5-step cone for 3-in. belt, and geared 6 to 1. Steps of cone so graded as to make cutting speed uniform for 5 different diameters of holes.

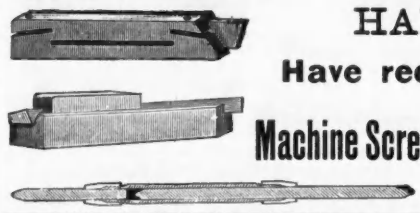
The Turret has 4 holes 1 3-4 in. in diameter, and is securely clamped in position. An adjustable dog allows the locking pin to be withdrawn at any part of its upward motion.

The Turret Slide has a movement of 21 in., and an automatic feed which can be easily and quickly changed from the finest ever needed to the coarsest required, it has quick return by hand, and is counter-balanced by a weight inside of column.

Price includes counter-shaft, wrenches, &c., all complete, delivered f. o. b. at Providence, R. I. Weight 4,400 lbs.

Illustrated Catalogue sent per mail, on application

THE PRATT & WHITNEY CO.



HARTFORD, CONN.

Have reduced the Selling Prices

—OF—

Machine Screw Taps & Combination Lathe Chucks.

Now discounting 35 per cent. on each.

The Billings & Spencer Co., Hartford, Ct.

MANUFACTURERS OF

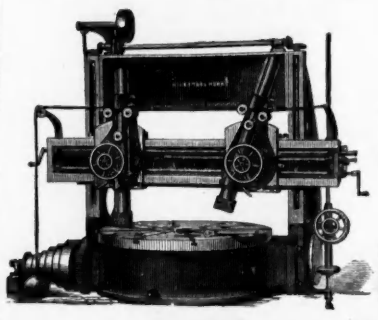
DROP FORGINGS IN COPPER, IRON OR STEEL.

Pure Copper Commutator Bars for Electric Motors or Generators, Steel Commutator Rings and Nuts, Steel Wrenches and Eye Bolts.

DROP FORGINGS FROM PURE COPPER.
THE BILLINGS & SPENCER CO. HARTFORD, CONN.

Boring and Turning Mills,

5, 6, 7, 8, 10, 12, 14 and 16 FT. SWING.



NEW MACHINE,

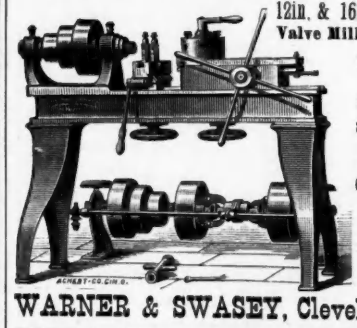
14–20 ft. Boring and Turning Mill. Housings and upper works arranged to slide back to take in work 20 ft. diameter. Has independent boring and key seating attachment.

NILES TOOL WORKS

Hamilton, Ohio.

NEW YORK, 96 Liberty Street. PHILADELPHIA, 713 Chestnut Street. CHICAGO. 96 Lake Street.

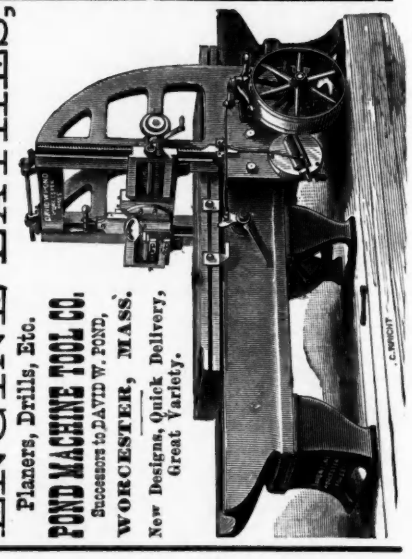
BRASS WORKING MACHINERY.



12in. & 16in. Monitors
Valve Milling Mach's
Double Key Lathes,
Speed Lathes
Slide Rests,
Revolving Chucks for Globe Valves,
Two-Jawed Chucks,
Small Tools and Fixtures.

WARNER & SWASEY, Cleveland, O.

ENGINE LATHES,



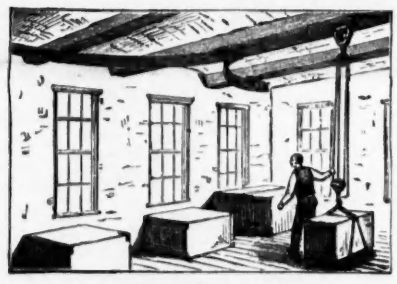
Planers, Drills, Etc.

POND MACHINE TOOL CO.

Successors to DAVID W. POND,

WORCESTER, MASS.

New Designs, Quick Delivery, Great Variety.



OVERHEAD TRAM-RAILS.

OVERHEAD TRAMRAILS,

—WITH—

Weston's Differential Pulley Blocks,

ANY CAPACITY.

The Weston Pulley Block is suspended from a traveler or trolley which runs freely on the lower flange of the track. The tracks, by means of curves and switches, can reach any desired points. Plans and estimates furnished on application.

SOLE MAKERS,

THE YALE & TOWNE MFG. CO., Stamford, Connecticut.

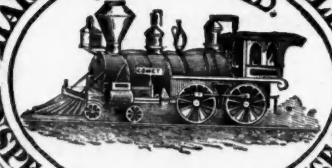
New York—Chicago—Philadelphia—Boston.

Catalogues on application.

GEO. W. FIFIELD,

Manufacturer of ENGINE LATHES from 16 to 48 in. swing. Cuts, Photographs and Prices furnished on application. Lowell, Mass., U. S. A.

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO.



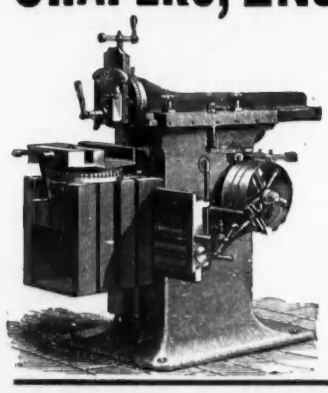
HARTFORD, CONN.

J. M. ALLEN, President.

W. B. FRANKLIN, Vice-President.

J. B. Pierce, Secretary.

SHAPERS, ENGINE LATHES & DRILLS.

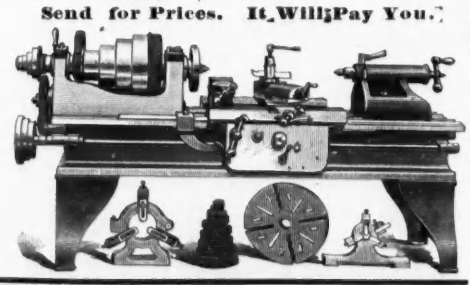


20 in. Upright Drill.
24 " " "
26 " Back Geared
30 " and
38 " Power Feed Drills.

LODGE, DAVIS & CO.

CINCINNATI, OHIO.

Send for Prices. It Will Pay You.

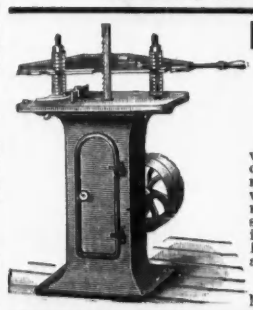


GEAR WHEELS & GEAR CUTTING

Send for Catalogue D.

GEORGE B. GRANT,

666 Beverly Street, Boston.



KEY-SEATING MACHINES,

and 20-in. Drills,

A SPECIALTY.

Our Key-Seating Machine will save enough in 60 days' use to pay first cost; no shop can afford to do without one. We have now ready for prompt shipment both Key-Seating Machines and 20-in. Drills. Send for Photo. and Catalogue.

W. P. DAVIS,

NORTH BLOOMFIELD, N. Y.

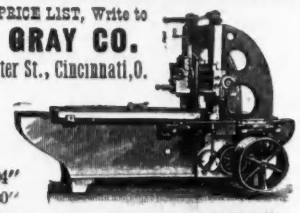
For New Reduced PRICE LIST, Write to

THE G. A. GRAY CO.

Sycamore & Webster St., Cincinnati, O.

Lathes, 17 in. 20 in.

Planers, 24"x24" 30"x30"



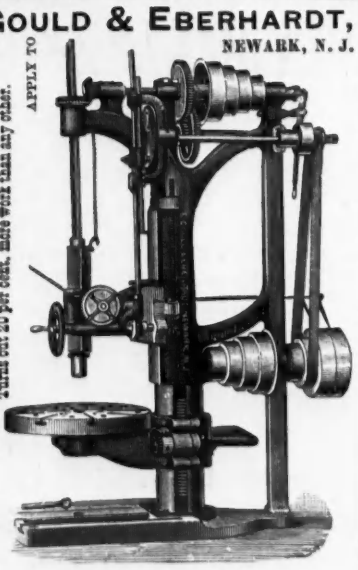
E. GOULD & EBERHARDT,

NEWARK, N. J.

Eberhardt's New Drill

Turns out 20 per cent. more work than any other.

APPLY TO



E. E. GARVIN & CO.

139 & 141 CENTRE ST., NEW YORK,

Manufacturers of

MACHINISTS'

TOOLS

Small Automatic Miller,

WITH ARM.

The Machine shown in cut is designed for rapid and convenient milling of small work.

Send for Catalogue.

THE BUFFALO STEEL FOUNDRY, BUFFALO, N. Y.

ORDERS AND CORRESPONDENCE SOLICITED

PRATT & LETCHWORTH
Proprietors.

FIRE

Destroyed our works one month ago; but we are so far recovered from its disastrous effects as to be able to announce to the public our readiness to receive orders. We have secured buildings for temporary use adjoining the ruins, into which we have already put over $30,000 worth of new machinery, the best that could be obtained, and are again ready for business.

We desire to express our thanks for the liberal patronage bestowed upon us in the past, and respectfully solicit a continuance of the same.

THE STILES & PARKER PRESS CO.

Middletown, Conn., Mar. 4th, 1887.

J. M. CARPENTER
PAWTUCKET, R. I.

Manufacturer of TAPS AND DIES